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BY

A. D. WEBSTER

AUTHOR OF "SEASIDE PLANTING," "FIREWOODS," ETC.

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PREFACE

THE pressing need of afforestation and the lifelong interest that I have taken in the subject have caused me to record my experience and observations. The Scottish laird's advice to his son, "Be aye stikin' in a tree, Jock; it'll be growin' when ye're sleepin'," was never more appropriate than at the present time, when the axe of the woodman should give place to the spade of the planter. The cultivation of timber where formerly heath and gorse abounded is equally laudable with the making of two blades of grass grow where only one grew before.

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NATIONAL AFFORESTATION

INTRODUCTION

Not only as a matter of national safety, but in order to provide timber for our every-day requirements, it is imperative that the Government should, without delay, not only replant areas that have been denuded for war purposes, but afforest at least a million acres of waste or otherwise unprofitable land. Commercially, forestry is in this country an almost unknown industry, its necessities and possibilities being but little understood, and that although we are the largest timber-consuming country in the world—larger, indeed, than all the countries of Europe put together. We have fully 15,000,000 acres of mountain and heath land where timber could be successfully and profitably cultivated, and yet the sum total of our woodlands previous

to the war was only 3,035,590 acres, a smaller percentage than that of any other country. The percentage of woodlands held by the Crown is only about 2¼ per cent., or a little over 66,000 acres. The produce of these woodlands is quite inadequate to meet our ever-increasing demands, which, roughly speaking, approximate 11,000,000 loads annually, the total value of which exceeds £33,000,000.

Time after time the writer has urged on the Government the pressing necessity of extending the woodlands of our country, so that a great national industry would be brought about, and that we might be less dependent on foreign supplies. But little or nothing has been done, and, broadly speaking, the position stands thus: In Scotland the Government has planted a few thousand acres of land, while some of the larger city corporations have done good work by afforesting the catchment areas of their water-supplies, and in Ireland some planting of rather an experimental nature has taken place. This,

with the little efforts that have been made by private landowners, is the sum total of our planting operations. There are, perhaps, no exact statistics of the total quantity of standing timber that we possess, but according to the most reliable estimates about 3,000,000 acres out of a total of 77,000,000 acres are wooded, and the value of this may be roughly conjectured as about £33,000,000. Now, previous to the war our annual imports amounted to fully £45,000,000, or, in other words, the total value of standing timber in the British Isles is less than has been yearly spent on purchasing that commodity from abroad. Assuming that the war had continued for another two years with the restricted imports, there would have been little or no timber left standing in this country. This is a wrong state of matters, that can only be put right by the Government, at once, planting up at least a million acres of land during the next twenty-five years.

It is most unfortunate that the tendency of the war has been to seriously check planting

operations, and at the same time to greatly increase the felling of all kinds of timber. The war has certainly brought home to us in a clear and unmistakable manner the danger of relying too much on foreign supplies of timber, and it is to be hoped that after peace we will settle ourselves down to make amends, not only for past neglect in that way, but in order to make up for the lost ground, by re-planting some, at least, of the land from which timber has been felled. But the matter must be viewed in a still more serious light, for unless the Government take steps to stop the present tendency to check planting and hasten felling, another year of war would most certainly have found this country seriously denuded of its best timber.

We are no pessimists, but unless something is done, such as by Act of Parliament, to either induce planting or stay the axe of the woodman, the woodlands of our country will be sadly depleted in another year or two. Heretofore the State has done extremely little either in extending the area of our

woodlands and plantations or in inducing owners of suitable lands to do so themselves.

The war has made unusually large demands on timber all over the Continent, as well as at home, and it is quite possible that, with foreign supplies greatly diminished, we will be compelled to still further make severe inroads on our own resources. To those who rightly regard our forests as a national asset it is quite plain that, in order to keep up supplies for the future, replanting of ground from which a timber crop has been cut and the afforesting of fresh areas is the only feasible way of facing the difficulty.

When we consider that the total area of woodlands in this country is only a little over 2,000,000 acres, that fully 15,000,000 acres of waste lands exist, and that we annually import over 10,000,000 tons of timber at a cost of over £45,000,000, the necessity for an increased area of woodlands will be apparent to all, and all the more so as a dearth of timber is imminent and outside supplies are being

rigidly conserved, while our home demands are ever on the increase.

Taken as a whole, Europe has not enough timber to meet her demands, about 4,000,000 tons in excess of what she produces being annually required, and stringent laws have been passed regulating the output. This is the case with Norway, Sweden, Finland, and Russia. The Canadian forests and those of the United States are both nearly exhausted, and by a competent judge it has been said that in fifteen years little or no timber will be left if depletion goes on in these countries as at present. But the worst is that there are no forests to fall back upon, for the timber of those of Africa and India and South America is unsuited generally to our wants. Australia, China, and Japan require at present more timber than they produce.

For the past thirty years I have not failed to urge on the Government and private owners of woodlands the pressing necessity of planting up some, at least, of the waste and unprofitable lands of our country in order to

provide timber for the future, and leave us less dependent on the gradually dwindling supplies that are annually sent us from abroad.

England being, so to speak, a residential country, the retention of a certain amount of heath, mountain, and commons land for the purpose of deer forests, grouse moors, game coverts, and golf-links, is imperative, and will considerably reduce the amount of land available for afforestry purposes. But I think that I am well within bounds in allotting, out of the 15,000,000 acres of waste lands, 1,000,000 to afforesting and 14,000,000 acres to game preserves and recreation.

Having personally explored much of the mountain and heath lands in England and Scotland and some of the vast tracts of bog-land in Ireland (which alone extend to fully 1,125,000 acres), I have carefully computed that, of the land up to 1,200 feet where timber would grow perfectly well, about 9,000,000 acres are available for afforesting purposes. As far as I have been able to find out, the average rental of such ground would be con-

siderably under 3s. per acre, while, on the other hand, I am quite convinced that any land which does not bring in at least three times that amount for grazing or agricultural purposes would be more profitably employed in carrying a crop of timber. It is, perhaps, unfortunate that much of these waste lands is private property, the owners of which, even could they afford it, have little inclination to sink, for a period of, say, twenty-five years, the necessary capital required to be expended on the formation of woods and plantations.

Under such conditions the question naturally arises, What is the most feasible way to overcome the difficulty ? In answer, and without the slightest hesitation, I would say that suitable waste lands at the rate of 40,000 acres should be planted annually for a period of, say, twenty-five years. Such lands could, in England, Scotland, Wales, and Ireland, be gradually and cheaply acquired where the owner himself was unwilling to plant, and in Ireland vast tracts of bog-land would be willingly handed over at the present time

at a small sum per acre. Quite recently, in Wales, 7,412 acres of upland, described as "rough grazing and sheep walk," was sold by public auction for £15,670, or at the low rate of £2 2s. 3d. per acre. The land was particularly suitable for the growth of larch, as the highly remunerative plantations adjoining clearly pointed out. But numerous similar cases will be given later on so that the excuse of no available land is not tenable and could be dealt with by a waste land reclamation society.

After careful computation I have no hesitation in saying that the area of plantations in the United Kingdom could at once be doubled by the planting of waste lands which at present do not bring in over 2s. per acre rent annually, with infinite benefit to the country generally and a vast increase in the value of land both to the owner and farmer who cultivates it. I have already suggested that altogether not less than 1,000,000 acres should be planted over a period of twenty-five years at the rate of 40,000 acres per year,

which would be an outlay of about £290,000 annually—a small sum, it will be admitted, when compared with the £45,000,000 yearly expended by this country on supplies brought from abroad.

My original scheme of afforestation was, however, on much more ambitious lines, the proposal being that 3,000,000 acres should be planted over a period of twenty-five years, at the rate of 120,000 acres annually, this, with the existing 3,000,000 acres, making a grand total of fully 6,000,000 acres of woodlands, the produce of which would leave us to a great extent independent of foreign supplies.

But supposed difficulties in the matter of procuring suitable land and the necessary money and labour knocked the proposal on the head, and the lesser scheme was substituted as more likely to find favour with those who will have to provide the necessary funds for carrying out this pressing and important work.

Now, however, that a timely lesson has been learnt as to our timber requirements in time of war and the present sadly depleted

state of our woodlands, it is to be hoped that no grudging hand will be stretched out against the rendering of the British Isles as far as possible self-supporting in the matter of timber.

At present we have less than 3,000,000 acres of woodlands, or 4 per cent. of the total area of land in the United Kingdom. Between 12,000,000 and 15,000,000 acres of waste lands have been mapped out as suitable for tree-planting, so that the proposed 3,000,000 acres would work out at considerably less than one-half of the available area. In order to reduce expenses it was proposed to extend the planting of the whole area over a period of twenty-five years, at the rate of 120,000 acres per annum. The cost of so doing, including purchase of land, would work out at £900,000 per year. There are advantages in spreading the planting over a period of years, as by the time the last portion was dealt with, the first planted sections should be worth at least £60 per acre, which might be looked to as a permanent yearly return. Besides this, actual returns from coniferous plantations

have proved that up to sixty or seventy years there is an annual return of 15s. per acre per year for thinnings. The cost of felling and converting the timber on each 120,000 acre section would approximate £50 per acre, or a total of £6,000,000, to which should be added another £2,000,000 for haulage and railway carriage, this work giving constant employment to about 70,000 men. Taking the cost of planting each year, this would represent work for fully 4,000 men.

From carefully compiled figures, based on the experience of the past thirty years, the afforesting of waste land which at present brings in an annual rental of under 3s. per acre would yield, after paying cost of land and planting, 42s. for larch and 20s. for Scotch pine and spruce.

CHAPTER I

HISTORY OF BRITISH WOODLANDS

THE face of England has changed considerably since the days when Julius Cæsar described it as "one horrible wood," and when his soldiers had to hack their way from Deal to London. Nearly all these primeval forests that barred the march of the Roman soldiers have disappeared. At that period and for many centuries afterwards we had plenty of timber and little use for it, a striking contrast to to-day, when we are left with little timber and such a demand that before the war our bill for the wood we imported stood roughly at £45,000,000 annually. War greatly increased the demand, while submarines reduced the supply, and as a result we were compelled to fall back on our home-grown timber, only to find that economic forestry was one of the many home industries that we had neglected

and quite forgotten to establish. Then, too, we found out that whereas France and Germany had half an acre of woodlands per head of the population, Britain could barely average a fifth of that amount.

Early historians tell us that in their day, not only England, but the greater part of the British Isles, was forest land; but as time progressed and the population increased, the calls for timber gradually reduced the area and density, until to-day the sum total of our woodlands is less than 3,000,000 acres out of a total of 77,000,000 acres. The South of England was particularly well wooded, trees and underwood extending in an almost unbroken line from east to west, while both the Midlands and North had their detached forests. Remnants of the southern woodlands are Epping, Richmond, Windsor, and the New Forest, while Sherwood, with its memories of Robin Hood, was one of the best-known and most valuable of the earlier forest lands. Scotland had its great Caledonian Forest, while the famous Shillelagh and other

forests in Ireland, particularly in the County Wicklow, stretched in an almost unbroken line from the Atlantic to the Irish Sea. In the Domesday Book (1081-1086) mention is made of forests in Berks, Hants, Dorset, Wilts, and Gloucestershire; while no less than 156 forests are described in the Royal Forests of England.

When the early Britons settled in London, thick, almost impenetrable forests of oak and scrubwood covered the high ground where St. Paul's Cathedral now stands, and extended away towards the Tower on one side and to Highgate, Hampstead, and St. John's Wood on the other. Previous to the Great Fire of London in 1666 most of the 65,000 picturesque old framework houses were built of wood, and in order to accommodate some 400,000 souls and their belongings large quantities of timber must have been requisitioned, not only for the erection, but in the repairs to these unpretentious structures. As little or no foreign wood was imported at that early date, it is only reasonable to suppose that home-grown

timber entered largely into their construction; indeed, samples of charred wood from the Great Fire that I have been privileged to examine were all of oak or chestnut, and of very excellent quality. London in those days was, however, well situated for obtaining supplies of native timber, and as the nearer forests became exhausted the builder went further and further afield for his oak and elm, much of which was obtained from the Sussex and Surrey woodlands. There are still several interesting remains of oak and chestnut timber that were used in the construction of thirteenth and fourteenth century buildings; but many have been pulled down during the past century, some of which would include the wooden galleries of the "Four Swans" in Bishopsgate Street, the Tower of London and Peter Pindar's house, which were some of the finest examples of early woodwork. Then the roof of Westminster Hall is acknowledged to be the most perfect wooden structure in the world, the oak of which was obtained from the Surrey woodlands during the reign of

Richard II. To-day the greatest part of the oak is in perfect condition, though some of the logs have been badly attacked by insects. The original roof of 1098 was of Irish oak obtained by King William Rufus from the Wicklow hills. The cloister alleys of Durham Cathedral is another early and splendid example of the beauty and lasting properties of British oak; while Cochwillam barn, in Carnarvonshire, contains quantities of the hardest and most beautifully coloured oak timber that I have ever seen. The massive roof of St. Paul's Cathedral was formed of oak from Welbeck in 1695. In rebuilding London after the fire large quantities of timber were brought from the adjoining forests, notably those in Kent, Sussex, and Surrey, as well as Middlesex and the heights of Hertfordshire. From Kingston-on-Thames it is also on record that remarkably fine oak timber was brought to London.

But as well as buildings, the consumption of timber as fuel must have been considerable at that early date, and so helped towards the destruction of the woods and forests, for it is

only during the past century that coalfields were developed. Large quantities of the finest oak and other timber from the Sussex forests were also converted into charcoal to be utilised in the production of the far-famed Sussex iron, which had a wide reputation and was largely manufactured until the requisite timber for producing the charcoal run out. It may be of interest to mention that the massive iron railings which partially surround St. Paul's Cathedral were amongst the last production of these Sussex ironworks. With the disappearance of the timber, the charcoal-burner was unable to follow his occupation, and so one of the earliest and most interesting of our woodland industries came to an end.

At what date timber merchants appeared on the scene would be difficult to say, but we know that pine-wood was imported from Norway to this country in 1656, though only in small quantities, as we find from the Geographical Directory that even as late as 1815 the annual value of deal sent from Norway did not exceed £175,000. The home

or English timber merchant is, however, of much older standing than the foreigner, and probably dates from the beginning of the fifteenth century, as we find that in 1407 one William Pomfrett, a timber merchant on the borders of Sherwood Forest, was indicted at Nottingham for placing timber upon Tymberhill on the King's highway to the nuisance of the neighbours; and, moreover, through the default of that timber there lying, John Ward, a barber, was killed. Actual sales of timber even at an earlier date are recorded, as in 1379 John Turner entered a debt of 6s. 8d. (about £5 of our money) in the court against a publican for "timber pertaining to an ale booth" which should have been paid for at the Feast of St. Martin. As early as 1290 Queen Eleanor, wife of Edward I., set up large timber works at Glencree, in Ireland, to supply timber for her castle at Haverford in Wales.

The records of the Worshipful Company of Carpenters, which were fortunately saved from the Fire of London, make no reference to the home timber merchant previous to

that date, and no guild or company of such trades is known to have existed. It is therefore probable, though we have authentic accounts of timber merchants in other parts of the country, that in and around London the dealer in timber was in all probability combined with the carpenter or wood-worker. Regarding timber-yards, we know that early in the sixteenth century, on the bank of the Thames, a considerable plot of ground was set apart for the storage of such materials as were required for keeping London Bridge in repair, and several pit-saws were at work along the stream. Here, again, it is only reasonable to suppose that the materials used for the repairs of a wooden bridge would consist mainly of timber, and the plot of ground be a timber-yard. For the rebuilding of London foreign timber was imported, but the houses, though mainly erected of stone, were often lavishly embellished with oak panelling and carvings from one or other of the adjoining forests.

Most of the timber in those early days was cut into boards and planks by the pit-saw,

several of which could be seen at work within easy reach of old London Bridge. Strange though it may sound, a pit-saw is to-day at work in Westminster Hall converting the oaken logs into the requisite shapes for repairs to the ceiling. When the first sawmill was erected it would be difficult to say, but probably not earlier than the middle of the fourteenth century, and the Bishop of Ely, in 1555, quaintly describes one he saw at Lyons as "being driven by an upright wheel, and the water that makes it go is gathered whole in a narrow trough which delivereth the same water to the wheel." In 1633 a Dutchman erected a "wind sawmill" near the Strand.

The pit-saw at use in Westminster Hall to-day recalls to memory the old method of converting logs before the circular or bench saw was introduced. As late as a century ago it was not uncommon for timber to be sold in London "by candle," meaning that bidding could continue while a certain portion of the candle was being consumed, and sand-boxes were used in lieu of blotting-paper.

Regarding the scarcity of home-grown timber and need for tree-planting, the earliest warning I have been able to find is that in August, 1608, Philip Cottingham, of London, Carpenter, was sent over to Ireland to report on timber for the Navy and sent fifty-six tons to the Thames as a specimen. In "Practical Husbandry," published in 1656, the author writes as follows: "Now, the multitude of timber brought yearly from Norway and other parts does plainly demonstrate the scarcitie thereof here; also it may be conjectured what a miserable case the Kingdom will be plunged into in an Age or two hence for want of Timber." Again, Evelyn in his "Silva," published in 1662, gave an historic account of the sacredness and use of standing groves with reference to an enquiry regarding oak timber for the Navy. A few years later, in 1675, Dr. Thornton said: "The deputies or lieutenants of the Duke of Newcastle, Justice of Eyre of all His Majesty's forests North of the Trent (after 1660), have allowed such and so many claims that there will not very shortly

be wood enough left to cover the bilberries." In 1731 the question was brought before the Irish House of Commons in an Act (the 5 George II. c. 5) " To encourage the improvement of barren and waste lands and bogs, and planting of timber trees and orchards."

But even from the time of the Norman Conquest enquiries have from time to time been made regarding our available timber supplies, especially with reference to oak for building and keeping in repair the " Wooden Walls of England." From official and other papers I have had good opportunities of learning what vast quantities of special oak-trees were felled in the Royal and other forests in connection with the upkeep of the Navy. Even in two of the London parks upwards of 4,000 picked oak-trees were felled for the Navy and mercantile purposes during one season, 2,976 being from Regent's Park, in the very heart of the Metropolis.

But coming down to later times, we find that Lord Kames, writing in 1776, said: " Considering the great quantity of waste

land in Scotland, fit only for bearing trees, and the easiness of transporting them by navigable arms of the sea, one cannot but regret the indolence of our forefathers who neglected that profitable branch of commerce, and left to us the necessity of purchasing foreign timber for every use in life."

On no less than seven occasions during the past thirty-two years has the question of afforestation been brought before Parliament, while private conferences would treble that number. There have been, in addition to private meetings, a Select Committee, a Departmental Committee, a Committee to consider the Desirability of Tree-planting in Ireland, Royal Commission on Coast Erosion, and the Forestry Subcommittee of Reconstruction, at all of which much valuable information was given, not only as to the pressing need of afforestation, but financial results that have been obtained in various parts of the country from properly managed plantations. The Forestry Subcommittee of Reconstruction has now issued its report, to which

special reference is made in Chapter XIII. It is sincerely to be hoped that this report will not follow its predecessors into oblivion, but be adopted and carried into effect without delay. Briefly the scheme is that 1,770,000 acres of coniferous forest which it is proposed to create are reckoned to be mature at 80 years, and the whole area is to be planted up within that period, 250,000 acres in the first 10 years, and the remainder in the following 70 years. It is with the first 10 years that the published scheme deals. Of these 250,000 acres 50,000 are to be purchased, 100,000 leased, 25,000 treated on a proceed-sharing basis, 25,000 dealt with by local authorities and private persons, and 50,000 to be replanted.

Regarding the utility of timber, it may truly be said that from the time we get up in the morning till we retire at night, from the cradle to the grave, we are daily availing ourselves in one way or another of the products of trees. Timber, whether in a converted or unconverted state, is essential in practically every form of commercial enterprise, including

railway construction and maintenance, ship building and repairing, street-paving, building construction, and for mining purposes generally; while the wheel and cart wright, maker of agricultural and other implements, cooper, furniture and packing-case maker, are almost entirely dependent on timber for carrying on their profession. In every country it is noticeable that the more civilised a community becomes, the greater are its requirements for timber, both in the round and converted state. In connection with home-grown timber, one of the most instructive and enjoyable mornings that I have ever spent was in examining the five-century-old colossal oak beams and purlins on the roof of Westminster Hall. The roof is truly a marvel of oak timber and engineering construction, and may well be described as "one of the finest feats of carpentry extant."

CHAPTER II

THE APPROACHING DEARTH OF TIMBER

THE Controller of Timber Supplies informed the Council of the English Forestry Association that there was a world shortage of timber. In the United Kingdom there were approximately 4,500,000 standards still unfelled, and during the next twelve months it has been estimated that for reconstruction purposes 350,000 standards of good timber will be required. These demands are for national requirements such as house and ship building, railway and engineering works of all descriptions. Calculating on the rate of output during the war, it has been carefully computed that the timber still left standing in this country would last about eighteen months.

By those who are best competent to judge, repeated warnings have been given as to an approaching timber famine. The late Presi-

dent Roosevelt said with reference to the United States: "If the present rate of forest destruction is allowed to continue with nothing to offset it, a timber famine in the future is inevitable. Remember that you can prevent such a famine by wise action taken in time, but once the famine occurs there is no possible way of hurrying the growth of trees necessary to relieve it." These remarks, made some years since, are amply corroborated by the following figures which have just been published regarding the wood imports and exports of the United States:

"For nearly three years now we have been confronted with the stubborn fact that we actually import more lumber and timber products of all kinds than we export. There is every chance, too, that this change will continue to grow upon us till, instead of seeking for an outside market for timber and lumber, we will be seeking outside for a timber supply to help provide for our domestic needs.

"Taking the fiscal year ending with last June, and in round figures our imports of

wood and manufactures exceed the exports by about $10,000,000, the exports rounding out about $85,000,000 and the imports totalling something like $95,000,000. Back before the war started in Europe we had an export trade that had reached beyond the 100,000,000 mark. After the war started it fell off to about 60 per cent., and it has since recovered to something near 80 per cent. of the original volume, though the bulk of the trade is going to different points than formerly. Meantime, however, we have been adding to our own outside purchases, till now we are buying more than we are selling. So far the big feature in the gain of imports over exports has been in pulp and pulp wood, but there is an increase in the timber and lumber purchases proper.

"Our imports are made up of mahogany, cedar, and other cabinet woods, mainly in log form, amounting to something like $5,000,000 a year. Then we have lumber proper, much of it coming from Canada, which runs up to something like $40,000,000, pulp wood about

$10,000,000, and wood pulp about $25,000,000. The balance is made up of rattan, reeds, etc.

"Our exports show a total of lumber proper just about equal to that of our imports, so the main gain of imports over exports is in the pulp wood and wood pulp, though we export some wood pulp too. The fact that we do import even to-day lumber proper in an amount equal to, and promising to exceed, our exports is significant as possibly marking the beginning of a new era in our relation to the outside world in the matter of timber products. All authorities agree that at the rate we have been going for a number of years we will eventually reach the point where there will not be enough timber stumpage to supply domestic needs, unless the needs are cut down or some way is discovered to make the stumpage go much farther. Our present import and export figures point towards the conclusion that we have already reached the point where we will need to import more than we export, which would make us a timber-buying rather than a timber-selling country.

"There is that in the situation which should furnish food for serious thought on the part of those prominent in lumber-production in the United States."

Again, the late Mr. Lewis Miller, who had vast forests both in Sweden and Nova Scotia, told me that in twenty-five years neither the United States nor Canada will have much timber left, while Sweden and Finland are already played out. "I am also of opinion," he says, "that during the next twenty-five years timber will be double its present price, and that it will not only pay to plant land valued at 3s. per acre, but that worth 20s. per acre."

Canada, with its 798,000,000 acres of woodlands, sends its entire surplus to the United States. It may be said by some that the timber of our foreign possessions will partly fill up the gap, but such is not the case. Indian timber, principally teak, is not in request to any appreciable extent, while the great African forests are hardwoods, and as a rule unsuited to our wants. The forests of

South America are on a par with those of India and Africa, while China, as also Australia, require more timber than they possess.

Although large territories of forests, especially in China, Korea, India, and South America, remain to be utilised, it is certain that the question of the future wood supply of the world, now attracting the attention of economists, will continue to excite great interest. Japan is better off in the way of timber. In Japan proper there are some thirty kinds of good timber trees, and over 200 varieties if we include all others which may be called subsidiary timber trees. The area under forest amounts to 47,264,000 acres, being about one-half of the entire area of the country. The Japanese authorities have always taken an interest in the protection and preservation of forests and woodlands. Russia has vast forests of splendid timber from which we will be able to get some of our supplies, which is specially referred to in Chapter XIII.

Than timber no article is probably more indispensable to the welfare of a nation,

entering extensively, as it does, into almost every trade and industry. For England, therefore, with an ever-increasing import, the possibility of a dearth of timber must be regarded with the keenest anxiety, more particularly as such would entail prohibitive prices and seriously cripple the trade of the country. The following table, as reported to the Washington Bureau of Manufactures, will show at a glance the annual imports of timber of the principal countries of Europe:

England ...	...	16,342,600 cubic yards
Germany ...	...	11,766,667 „
France ...	...	8,496,300 „
Belgium ...	...	1,897,777 „
Italy ...	...	915,148 „
Denmark ...	...	849,630 „
Spain ...	...	392,222 „
Switzerland	...	313,778 „

In face of this it is only reasonable, therefore, to suppose that the Government should act promptly in the matter, remembering that no scheme of afforesting, however extensive or well ordered, can bring the necessary relief for at least forty years after its

inception. For all this, and in spite of numerous warnings as to the pressing necessity for tree-planting and the ominous signs of a timber famine, little or nothing has been done, save the holding of meetings by the Board of Agriculture and the purchase of a few hundred acres of waste land in Scotland. To sum up briefly, the situation is this: England's imports have rapidly increased from a trifle under $3\frac{1}{4}$ million loads in 1864 to fully 10 million loads in 1906, thus showing an increment of fully 7 million loads in forty-two years.

Most European countries have large internal supplies of timber, so that, by a system of conserving and protective tariffs, the pinch of want would not be felt severely for years to come. But not so England, which is almost wholly dependent on supplies sent from abroad.

These are no idle words, but the records of those who know well what they are talking about; neither are the writers in any sense pessimists. With all these warnings from men whose business it is to study the question

and who are fully qualified to advance an opinion, surely it is time that we took up seriously the question of afforestation.

It goes for the saying that much of the best timber of our country has been sacrificed to meet the requirements of the war, some of the oldest and finest plantations of Scotch pine in various parts of Scotland in particular having been felled. Hardwooded species have not, however, suffered to the same extent, though the country has been practically skinned of its best ash, and heavy consignments of the biggest beech have followed suit from such places as the chalky districts of the Chiltern Hills and other parts of the adjoining counties. However, we have as a nation this consolation, that our home supplies of timber, with, practically speaking, little from old pre-war sources, have tided us over a four years' demand for war purposes of which the world has never had an equal.

CHAPTER III

TREE-PLANTING BY THE STATE

On no less than seven occasions during recent years has the question of Afforestation and a School of Forestry been brought before the House of Commons. There have been private sittings, Select Committee, Departmental Committee, a Committee to consider the Desirability of Tree-planting in Ireland, Royal Commission on Coast Erosion, and the Forestry Subcommittee of Reconstruction, at all of which much valuable information was given, not only as to the pressing need of afforestation, but financial results that have been obtained in various parts of the Kingdom from properly managed plantations.

Two of the original pioneers of afforestation in this country were the late Sir John Lubbock and Dr. Lyons. I can well remember on a Sunday afternoon in his beautiful woods at

High Elms discussing the question with Sir John and Professor Marshall Ward, when the former decided to again approach Parliament on what he described as the momentous question of providing timber for the future and taking steps to promote the study of forestry in this country. A few days afterwards I mentioned the matter to Lord Derby, who, being an ardent arboriculturist, was much in favour of the proposed scheme, and told me to plant up any waste land on his estate at Holwood and on the newly acquired properties at Leaves Green and the Vale of Westerham. Shortly afterwards Sir John Lubbock persuaded the House of Commons to appoint a Select Committee to enquire into the best methods of developing British woodlands. This Report, which strongly urged the study of forestry and the commercial aspect of tree-planting, was, however, shelved, and no direct action taken till 1902, when, in order to enquire fully into the matter, a Departmental Committee was formed, but with no better results. Dr. Lyons's scheme fared no

better when a Committee was appointed to consider the possibilities of tree-planting in Ireland. Nine years ago hopes of afforestation were high, when the Royal Commission on Coast Erosion issued their Report, but again nothing was done.

Further than the planting of some ground at Knockmullen, in Ireland—which, by the way, was a complete failure—and the purchase of a comparatively small area of land in Scotland for experimental purposes, little has been done by the State towards meeting our wants in the matter of an extensive and well-thought-out scheme of tree-planting.

It was announced last November that the Government had appointed an interim authority to make preliminary arrangements for developing afforestation in the United Kingdom. The chairman is Mr. F. D. Acland, M.P., and there are representatives of England, Wales, Scotland, and Ireland. The representative of Scotland is Brigadier-General Lord Lovat, who acted as Director of Forestry in France for the British Army, and superin-

tended the felling of French woods for the British Army, so as to set shipping free for other requirements. The authority has power to obtain seed, raise nursery stocks, train foresters, make surveys, and initiate schemes of replanting and afforestation. A sum of £100,000 has been provided for these purposes.

Private individuals and public bodies have, so far as possible, assisted by the planting of estate lands and catchment areas, but this is about the sum total of our contribution to one of the most pressing and important of our national problems. It has been left to the war to bring home to the Government the pressing need of afforestation and the necessity for large and assured timber resources within its own boundaries.

Unlike agriculture, long periods have to elapse before the forestry harvest can be reaped. It will be obvious, therefore, that extensive tree-planting is quite beyond the power of the private individual unassisted. It is a State business, in which regularity of action and large wooded areas are first

necessities; but, unfortunately, in this country commercial forestry is but little understood—in fact, may be described as an unknown industry.

Extensive plantations of from a thousand to several thousand acres each, and in compact blocks, are required, for it is only in dealing with such areas that the planting, tending, thinning, and conversion of the timber can be most economically and profitably carried out. From the purely economic point of view, the many small plantations dotted over the face of our country are worse than useless, though exceptions might be noted, especially in Scotland, where a number of woods have been planted and managed on a commercial basis, and from which much of the timber for carrying on the war has been procured.

With compact blocks of forest 2,000 to 4,000 acres in extent, and with timber crops of mainly the same species in each, a continuity of supplies could be guaranteed, which under existing circumstances is quite out of the question. In many outlying districts all

over the country that are far removed from road and rail it is difficult—in some cases impossible—to get rid of the usual small amount of timber that is periodically cut down; but were large quantities of the same kind and a continuity of supply ensured, merchants would be tempted to make special transit and other arrangements, as well as offer a remunerative price for the timber, while railway companies would no doubt provide cheaper facilities for its transport. Our canal and other waterways might be profitaby employed in the carriage of timber.

With a lifelong experience of British forestry, I have become more and more convinced that, in order to carry out the work and to place such on a systematic and sound economic footing, State aid and the afforesting of large areas of land are first necessities. There are few landowners or capitalists who would care to embark on a large scheme of afforestation from which they cannot expect to reap a return during their lifetime; and while, for capital invested, a safe and sure

return is guaranteed by many mining and other industrial companies that are financially safe, attention will be directed to these rather than to a project that is experimental, and from which there can be no return for thirty or forty years. The resources and continuity of a nation will always make the State the best custodian of forest property; indeed, only the State can readily acquire the necessary land on the most favourable terms and in sufficient quantity for the purpose of extensive afforestation. Private individuals, or, indeed, public bodies, labour under many disadvantages in that respect, not the least, as before stated, being the length of time required before the money expended in planting can be even partially repaid, while regularity of action and large wooded areas are first necessities to successful timber culture. The question of national reafforestation has on several occasions been exhaustively dealt with by the writer and others during the past thirty years. As early as 1883 I drew attention to the matter in "Woods and Forests," and at later periods

in most of the leading journals and papers of the day, including a special article to the *Field* and the *Gardener's Chronicle*, while in my evidence given before the Select Committee on Forestry, and in a paper contributed by special request to the Board of Agriculture, I went fully into the question of afforesting, and pointed out the need for and saving to the country that would be effected by a well-organised scheme of tree-planting. In connection with such I suggested, as before stated, that as a start 1,000,000 acres should be planted over a period of twenty-five years, at the rate of 40,000 acres per year, which would be an outlay of £300,000 annually—a small sum when compared with the £45,000,000 expended for many years by this country on supplies from abroad.

The Forestry Subcommittee of Reconstruction has now reported that 1,180,000 acres are to be planted in the first forty years, which cannot be considered as an extravagant scheme, and is practically what the writer suggested twenty years ago and at several later dates since.

The Prime Minister recently said: "You also have forest lands which are unsuitable for higher cultivation. You have no idea how we were handicapped because we had to bring timber from Norway, Sweden, and Canada, when you have plenty of land in this country that in the old days used to grow fine timber." And the Subcommittee rightly remarks: "Dependence on imported timber has proved a serious handicap in the conduct of the war." It also estimates that approximately 100,000 acres will require to be afforested with hardwoods in order to render the Kingdom safe during future wars. Owing to the long rotation necessary for hard-wooded over coniferous trees, the planting of such must necessarily be carried out by the State, 150 to 200 years being nothing in the lifetime of an oak or elm. Restocking denuded areas, which are estimated at fully 1,000,000 acres, will mainly fall on the proprietors of these lands, and, owing to the enormous quantities of timber that have been removed from many estates, there will naturally be a tendency on

the part of the owners not only to strictly conserve what is left, but restock the denuded areas as quickly as possible. It therefore stands to reason that private enterprise can do little in the afforesting of large areas of waste land, which must be left entirely in the hands of the State.

Public bodies have in the past done excellent work in the planting of catchment areas of waterworks and mine-heaps, but such is infinitesimal when compared with what is required.

At the commencement of the war we had, roughly speaking, 3,000,000 acres of woodlands, much of which required thinning, in addition to which the quantity of field and hedgerow timber was a big and valuable asset. But, in addition to this, we have been receiving consignments of mining timber from France and other sources, and had, when the war commenced, a fairly good stock in hand of foreign woods. It has been carefully computed that a million acres of woodland have been denuded for war purposes, while minor

thinnings from small woods all over the country and that from field and hedgerow have been valuable additions in meeting the wants of the War Office during the past four years.

The greater proportion of heavy elm, ash, and a goodly supply of oak, has been from field and hedgerow, while the whole of the coniferous timber, including larch, spruce, and Scotch pine, has been obtained from woods and plantations.

Beech and sweet chestnut have been supplied from such well-known centres as the Chiltern Hills, and from large private properties, as Welbeck and Woburn. It was prophesied by some wiseacres at the beginning of the war that our available supplies of timber would be exhausted in two years. Such, however, has not been the case, and at our present rate of consumption it is calculated by those who have studied the question that there is still sufficient left to last for another two years. The afforesting, therefore, of at least a million acres of waste land and replanting of the denuded areas will

leave us with fully 4,000,000 acres of woodlands. No time should, however, be lost in setting to work, remembering that no scheme of afforesting, however extensive and well ordered, can bring the necessary relief for at least forty years after its inception.

CHAPTER IV

COST OF FORMING PLANTATIONS

As will be seen from the following figures, the cost of forming plantations did not in pre-war days greatly exceed £5 per acre, much depending on the nature of the soil, rate of wages, accessibility of the woodlands, and whether drainage and fencing had to be engaged in.

Comparatively speaking, wages are unusually high at present, though, as much of the preliminary work at least can be carried out by returned soldiers and sailors under Government supervision, the extra cost need not be prohibitive.

The particular method of forming the plantations, such as whether notch or pit planting is adopted, will have much to do with the actual cost; but as the former, which is by far the cheapest method, was almost wholly carried out in forming most of the

Scottish plantations, where the largest areas of the finest coniferous timbers were felled for purposes in connection with the war, there is no reason why in dealing with similar ground the same system should not be adopted. But almost everywhere north of the Tweed notch-planting on rough, exposed ground, where it is imperative that comparatively small plants should be used, is carried out, and which mainly accounts for the smaller initial outlay in Scottish plantations.

In order to get myself thoroughly posted up with the actual cost of forming plantations on several of the largest estates in Scotland, I approached amongst others the Woods Manager on the Countess of Seafield's estate at Grantown, Strathspey, and found that no less than 20,000 acres had been planted up during a period of forty-seven years at the modest figure of £2 per acre, including the cost of fencing. He kept one plantation of 1,000 acres specially separate, and it cost exactly 30s. per acre for planting up 3,000 trees per acre, and the cost of fencing was under 10s.

per acre. The trees used were purchased as one-year seedlings one year transplanted, and after being grown for a year in an exposed home nursery, were finally planted out at the age of three years. By experience it was found that these were the cheapest and most profitable trees to plant in sheep pastures or heath-land, as bigger plants would be a mistake, as they would be too much exposed to the storm and wind and would be blown to pieces. The fencing of these plantations never cost more than 8d. per lineal yard, ordinary block wire being used, and the posts were delivered on the ground by contract from timber merchants who have sawmills working on the estate. Such a fence will last for fifteen years, and is then allowed to go down. Before the land was planted it was let out for grazing at 8d. per acre, but after fifteen years a much higher rental for the adjoining land was received, owing to the shelter afforded by the trees.

In Aberdeenshire a large area of land was planted by a local nurseryman at 35s. per

acre, as a copy of the contract in my possession shows. Each man planted from 2,000 to 3,000 trees per day, and a boy was provided for every two men, the boy putting in the plant to each man, and the men were responsible both for working the spade and firmly tramping the ground around the plants. But many similar instances could be given of the formation of plantations on Scottish estates at from £2 to £3 per acre; but it should be borne in mind that such woods were formed for purely commercial purposes, which is seldom the case with English plantations. For various reasons pit-planting is usually adopted throughout Southern England, the cost in comparison with notching being proportionately higher, not only on account of extra labour in opening the holes, but the higher price of the larger and stronger plants that can be used. For all practical purposes, however, the cost of forming plantations, taking the British Isles as a whole, may be put down at £5 per acre, as the average of the following figures will show:

COST OF FORMING PLANTATIONS

England and Wales.

	£	s.	d.	
Carnarvonshire, partial fencing and planting up to 600 feet altitude ...	5	2	0	per acre
Carnarvonshire, planting and fencing up to 1,200 feet altitude ...	4	18	6	„
Gloucestershire, planting and fencing up to 1,200 feet altitude ...	7	10	0	„
Kent, planting and fencing ...	6	3	0	„
Lancashire, planting and fencing up to 1,200 feet altitude	6	0	0	„
Lincolnshire, planting and fencing ...	8	0	0	„
Yorkshire, planting and fencing up to 600 feet altitude	4	18	9	„

Average cost per acre £6 1s. 9d.

Scotland.

	£	s.	d.	
Aberdeenshire, planting only ...	1	15	0	per acre
Blair Athol, fencing and planting 3,665 acres	2	10	0	„
Granton, Strathspey, fencing and planting 20,000 acres	2	0	0	„
Inverness-shire, Glengoy Estate, 800 feet altitude	3	10	0	„
Perthshire, planting only ...	2	10	0	„
Ross-shire, up to 1,200 feet altitude	2	10	0	„

Average cost per acre £2 9s. 2d

IRELAND.

	£	s.	d.	
Armagh, bog-land	5	2	0	per acre
Tyrone, partial soiling	6	1	0	„
Wicklow, 700 to 900 feet altitude, fencing and planting	4	13	11	„

Average cost per acre £5 5s. 8d.

It may be well to emphasise the fact that in all afforesting schemes special attention should be directed to the formation of a block of plantations in the vicinity of industrial centres, or as close to the consuming centres as possible.

Another instance in Scotland may be recorded, in which 550 acres were planted at a cost of £1,178, or at the rate of £2 2s. 10d. per acre. This included—fencing, £164 18s. 4d.; drainage, £123 15s.; plants, £520 10s.; planting, £368 16s. 8d.

In connection with these figures it may be assuring to state that in each case a strict account of the expenditure involved had been carefully noted, and the returns given are practically correct. According to these returns

the average cost, therefore, taking Great Britain as a whole, would be less than £5 per acre for fencing and planting the ground Most of the above-named plantations were formed on the very class of ground of which we have so much lying idle or bringing in only a few shillings rental per acre in various parts of the country. The Ross-shire plantation referred to was a bleak and barren moorland which the crofters, who used it as a common for their cattle and sheep, refused to rent at 1s. per acre per annum; while at Strathspey the 20,000 acres of land were let out previous to planting at 8d. per acre per annum. Vast tracts of the bare hill-sides of Wales are only bringing in a few shillings of rental per acre, special reference being made to the Snowdon range of hills in the north and Cader Idris in the south of the Principality. Near the famous Penrhyn Slate Quarries, in Carnarvonshire, the writer formed several plantations on land that gave an annual return of under 2s. 6d. per acre. The late Lord Powerscourt, who planted largely on his Irish estate, men-

tioned that the cost of forming plantations depended mainly on organisation, and that in his own case the areas of afforested land had given quite satisfactory returns at a low cost of original outlay. Two plantations cost £2 12s. and £2 15s. respectively per acre.

It should be remembered that all the above-mentioned plantations were formed on bleak, exposed moorlands—the very class of waste lands that I have so strongly advocated as the woodlands of the future, and of which at the present time there are about 15,000,000 acres lying idle in various parts of the Kingdom. Taking the cost of planting as £5 per acre, this, with £2 5s. for cost of purchase and 5s. for incidental expenses, would bring the initial total expenditure to £7 10s. per acre. Elsewhere I have suggested that 1,000,000 acres should be planted over a period of twenty-five years, at the rate of 40,000 acres a year, which would be an outlay of £300,000 annually—a small sum when compared with the £45,000,000 expended each year by this country on supplies brought from abroad.

But there is another point that I should like to touch on whilst dealing with the formation of plantations, and that is that the work should only be entrusted to the efficient and practical wood manager or forester, who is fully conversant with the whole routine of woodland work. It is frequently urged that forestry does not pay, but where such is the case it is generally traceable to injudicious planting and wrong methods of management. No more can we expect the gardener, gamekeeper, estate joiner, or even land agent, to undertake economical timber culture than we could expect the forester to carry out successfully the duties of any or all of these individuals. Wrongly formed plantations are, unfortunately, far too common, in so far, at least, as adaptation of soil and trees are concerned, the results being that, financially speaking, the woods are a failure, and proprietors, in consequence, fight shy of further planting operations. Not once, but over and over again, have I examined and reported on such woods in various parts of the country,

some of the most noticeable being in Nottinghamshire and Kent, where large areas of ground were planted with oak, for the successful culture of which the soil was quite unsuited, the result being that in sixty years the average cubic contents of each tree was only a shade over 10 feet in one instance and 13 feet in the other. In another case a gravelly area of large extent was planted with larch, the result being that the whole of the trees were "pumped" or rotten at the core, and had to be removed when five-and-twenty years planted. But many instances of a similar kind could be quoted. When pressing home the question of the extension of plantations, I have more than once been confronted by the statement that past experience does not warrant further expenditure in that way. That such is true cannot be denied—in many instances at least—but then, as above stated, faulty methods of formation and management are alone responsible for the failure.

Tree planting on the Birmingham watershed grounds cost £7 6s. 6d. per acre for between

400 to 500 acres, as follows: Planting, £4 2s. 8d.; clearing and fencing, £3 0s. 6d.; sundry charges, 3s. 4d. The Corporation of Liverpool have planted somewhat extensively at a cost of £6 15s. 3d. per acre, including clearances and a large expenditure for plants.

In connection with these returns it should be distinctly remembered that they are pre-war rates, and would, in all probability, be 50 per cent. higher at the present time.

The returns are, however, actual prices paid for the planting of land in various parts of the country, and can all be vouched for.

CHAPTER V

FORMATION OF PLANTATIONS

WHENEVER possible, the boundary-line should be laid out with a due regard to the shelter afforded to adjoining lands and to the plantation itself, and it should also be remembered that along continuous straight lines of trees severe storms will exercise their full destructive force. The form of outline must also be regulated by the prevailing winds of the particular district, and should present a convex side towards it, as it is obvious that on such a surface the storm would expend itself in opposite directions and so lose greatly in destructive force, and particularly is this the case on exposed and high-lying grounds.

Having obtained, surveyed, and marked out the boundaries, the next preliminaries will be fencing, clearing the ground of rough-growing

vegetation, and attending to drainage where such may be found necessary.

Local circumstances will sometimes go far in deciding the class of fencing to be adopted. Probably where stones are abundant it may be wise economy to form a wall as boundary to the plantation, and this not only acts as a fence, but affords excellent shelter as well. Then there is the ditch and quick hedge and the wood and wire fence, both of which are usually erected by the estate workmen. But cheapest and most efficient of all is iron and wire fencing, of which many kinds are now supplied for the purpose. Generally the fence is $3\frac{1}{2}$ or 4 feet high, with seven-strand wires, and is erected at a fixed price per yard by the makers. To recommend any particular type of fencing would be invidious, for amongst the numerous kinds now on the market any desired pattern can be readily and cheaply obtained.

Clearing the ground of all rough-growing vegetation that would impede planting operations should receive first attention. On exposed, high-lying ground this will readily be

carried out, as the growth of shrubs and grasses is usually dwarf in such situations, and will probably consist of heath, gorse, broom, thorn, and some of the rougher-growing grasses. Burning the latter during dry weather will suffice, but in the case of shrub growth such should be uprooted and burnt on the ground. On high and exposed sites nothing in the way of surface growth should, however, be removed, unless it interferes with planting operations.

Drainage and Laying Out the Roads.—From a practical point of view these operations may go hand-in-hand. Certainly, a most important item in the formation of a plantation is efficient drainage or the removing of stagnant water. Every part of the ground may not require drainage, and in many cases straightening and cleaning out existing water-courses will be all that is necessary. Where, however, stagnant moisture, which would be likely to affect the health of the young trees, is present, it should be removed, and in doing so every fall of the ground should be taken advantage

of. In commencing drainage, the position of the main outlet should first be determined, every fall of the ground being utilised. It is impossible to lay down rules as to the number, size, and distance apart at which the various minor ditches are to be placed, these points being only determinable when the nature of the soil, lie of the ground, and rainfall, have been carefully considered. The main drain may be 3 feet deep, 2½ feet to 3 feet wide at top and 1 foot at bottom. The minor drains, which should never be placed at right angles to the main, but at an angle of, say, 45 degrees, to prevent them from becoming choked in exceptionally wet weather, may be 2 feet deep, 2½ feet wide at top, and the width of the draining-spade at bottom.

Woodland roads are necessary for general access to the plantation when work is being carried out, for the removal of timber and firewood, and for sporting purposes. They should be formed before planting operations are taken in hand, and need neither be of an elaborate character nor attended with great

expense in the making. According to the size of the woodland, so should the roads be arranged, and, as before stated, considerable saving is effected by laying out the roads and leaving them unplanted. Usually they are 30 feet wide, and only require to have the surface levelled and a ditch cut along each side, this latter assisting materially in keeping the surface firm and dry. For various reasons, steep roads should be avoided by following in quickly sloping woodlands the general lie of the ground.

Pitting and Planting.—Having dealt with the various preliminaries connected with the formation of a plantation, the actual work of preparing the ground and inserting the plants will now be considered. Two methods of planting are usually adopted—pitting and notching, each having its warm supporters, and largely dependent on the site of the plantation and quality of soil.

The advantages of pitting over any other method of planting cannot, however, be questioned, and this is particularly the case

with ground that has hitherto been uncultivated. Compared with notch-planting, this system is far more expensive, but the future benefits to the plantation where pitting has been carried out are admitted by all practical arboriculturists. It must not, however, be assumed that, though pitting is preferable, the notch system is to be abandoned, for there are many rocky situations and moorlands where the latter would be the only practice feasible, and plants so inserted have often succeeded admirably.

The pits are made from 15 inches to 18 inches in diameter, if circular, or 15 inches if square, and the sides and bottom of each loosened by a pick; but in all cases the holes should be of a size sufficient to admit of all the roots being spread out to their full extent, and also to allow of a margin of loose soil to exist between the root extremities and edge of the pit.

Usually the pits are marked off by one man and dug out by several. In light, loose soil, or such as has recently been under cultivation,

the pits need not be so large. When opening the pits the grassy surface, if such is present, should first be removed and placed on one side, the soil being heaped on the other, for ease and convenience in planting. Before planting, the surface turf is placed in the bottom of the pit, and after being broken with a spade is covered with a few inches of fine soil, so as to make the pit of the required depth. The plants are then inserted, and as a further supply of soil is being added, they are gently moved to and fro and placed in an erect position before the operation of planting is completed.

The soil must be trodden firm amongst the roots, and when planted the young tree may stand about an inch deeper in the soil than when in the nursery border. The distance apart at which young trees may be planted will depend greatly on the situation and size of plants, but from 3 feet to 4 feet is a good average. In all cases the pits should be opened some time before planting is engaged in; indeed, where the soil is stiff or otherwise

unfavourable, a good practice is to carry out the work in autumn and plant the following spring, as by so doing the full benefit of a winter's frost in sweetening and ameliorating the soil is ensured. The cost of pitting varies greatly, according to the quality of soil and wages paid in the district, but from 1s. 8d. to 2s. 6d. per 100 is about the average.

During favourable weather tree-planting may be most successfully carried out from about the beginning of October to the end of February, but, generally speaking, autumn planting is to be recommended. There are, however, several exceptions, such as on exposed or maritime situations, on water-logged soil, and peat-bog, when spring planting is preferable; but in all other cases tree-planting in the British Isles should be commenced soon after the fall of the leaf, which usually takes place in the second or third week of October, according to season.

Notch-planting is certainly the most expeditious and by far the cheapest method of

inserting young trees under 15 inches in height. It is carried out by simply cutting the sod or surface by two strokes of the spade, and to a depth of about 5 inches, thus ⊢ or +. With the first stroke the spade is inserted in the ground in an almost perpendicular manner; it is then withdrawn and inserted at right angles to the first notch and close to it, and by pressing down the handle of the spade the split is opened up and the plant inserted from the blade of the spade towards the end of the opening. The spade is then carefully withdrawn, and the turf at the point where the notch or slit was made firmly trodden down, so that the opening is securely closed. This latter is most important, as if the air is admitted by way of the slit the roots become dry and the plant dies in consequence. Two persons, a man and a boy, are required to carry out notch-planting expeditiously, the man opening the slit and the boy inserting the plant. As before said, notch-planting is rarely practised, unless on bare and hilly ground, where large tracts of

upland in Scotland have been successfully planted in such a way.

The planting-iron is sometimes used in the formation of young plantations, particularly in rocky upland situations. It is 17 inches long, weighs 3 pounds, and can conveniently be used with one hand, but is only admissible where the ground is rough and the plants are small. Holding the iron slackly, the planter strikes it into the soil with sufficient force to drive the heart-pointed blade in about 4 inches or 5 inches. Then, with a downward and slightly twisted pressure to the right, the left corner of the turf is sufficiently opened up for the insertion of the roots of the plant. The iron is then withdrawn, and the upturned turf made firm by treading. Both notch-planting and planting with the iron cost about 30s. per acre previous to the war.

CHAPTER VI

TREES TO PLANT

From a purely commercial point of view, which must be the case in all large afforesting schemes, the best trees to plant are such as will produce the largest amount of the most valuable timber in the shortest space of time. We must not, however, entirely depend on such trees as have been found most valuable for war purposes, but study the industries and wants of our country, and plant accordingly. During the past four years the main call has been for Scotch pine, ash, and elm, these being urgently needed to keep pace with the requirements of the War Office and Air Board, the felling of which has denuded about one-third of our available timber supplies. Hardwoods, with the exception of ash, which will be extremely scarce for many years, have not suffered to the same extent as coniferous

timbers. In afforesting there must, however, be no hotchpotch system of planting a mixture of trees in one and the same plantation under the mistaken idea that if one species does not succeed another will. The intelligent forester knows perfectly well which trees are best suited for the particular classes of soils with which he has to deal; also such as are best suited for cold, exposed situations, whether by the seaside or at considerable elevations. Local requirements should also have a voice in deciding the particular class of timber that should be cultivated, such as pitwood in mining districts, beech where chair-making is the main industry, alder and birch where the demand for clog-soles is greatest, and elm and oak for the wheelwright and furniture-maker. Ash should be planted wherever the soil is suitable, apart altogether from local requirements, as future demand is sure to be great and distance will be little drawback to its fullest utilisation. The best quality of ash timber is well-nigh exhausted, though of second and third grades

there are yet small supplies left. Aircraft requirements will naturally receive first attention, afterwards agricultural implements and the wants of the carriage-builder will swallow up large quantities in order to make up for the past four years' deficiencies. Where soil is at all of a suitable quality we would strongly urge on prospective tree-planters the necessity of including the ash in young plantations, for demand is unprecedented and prices for first-class timber abnormally high. Even in a young state and at all stages of growth the ash is valuable. Beech should find a place in every calcareous or chalky formation where even a small depth of loam overlies the subsoil, while even in deep gravelly and sandy soils it produces a large quantity of useful timber.

Elm comes in useful everywhere, and is by no means particular as to soil or site, producing large quantities of timber whether planted as a hedgerow, field, or plantation tree. It is perhaps the most accommodating of our woodland trees, transplants readily, and grows

away freely, arriving at maturity at a comparatively early age. Oak timber is long in coming to maturity, but where soil is suitable this should be no deterrent to its being freely planted. A most useful and valuable tree for afforesting is the sycamore, for not only can it withstand severe storms, but it grows rapidly and produces a large quantity of useful timber. For dampish situations, which are bound to be present in large afforesting schemes, the willow, poplar, alder, and birch should not be passed over. The best class of willow timber, that of the "close-barked" (*Salix alba cærulea*), will be much sought after in the near future, not only for the making of first-class cricket bats, but artificial limbs as well. Coming into use at an early age—for the willow is fit for these purposes at the age of twenty or thirty years—is another valuable trait. This, with the alder and poplar, are all useful for naturally damp land, where most other species would not succeed in a satisfactory way, as well as being highly remunerative—the alder for

clog-soles and the poplar for using as the bottoms of carts and waggons for conveying stones, as it teases rather than splits or splinters.

Of late the wood of the sweet or Spanish chestnut is finding its level, for it certainly has been a neglected timber, though one of the best for frames of buildings and fencing purposes. Gravelly loam suits it well. More fitted for low-lying than exposed woodlands are the walnut, lime, and hornbeam, the timbers of which are valuable for many important purposes, but the trees require good soil.

Coniferous Trees.—It may seem somewhat strange, but it is nevertheless a fact that out of fully one hundred and ninety species of coniferous trees that are cultivated in this country, less than a dozen are valuable from a purely commercial point of view or the quantity and quality of timber they produce.

These include the common larch, Scotch, Corsican, and Weymouth pines, the common

and Sitka spruce, and the Douglas fir. Other species, such as the Austrian pine, are valuable for the shelter they afford, while for growing in pure sand by the seacoast the cluster or maritime pine has been turned to good account. For strictly economic planting, however, which must have first precedence where large areas are to be afforested, the above species of coniferous trees can alone be recommended, and will no doubt enter largely into every extensive scheme of tree-planting that will be engaged in, either by the Government or private individuals.

Larch.—Long experience has pointed out that as a profitable timber tree the larch has no equal amongst coniferous kinds that are cultivated in this country. The timber is in greater demand and sells at a higher price per cubic foot than that of any other conifer of home-growth. When we combine its great aptitude to suit itself to nearly all conditions of soils, altitudes, and diversities of climate with its long-established value as a timber-producer, rapidity of growth, and ease of

culture, it is clear that no other coniferous tree cultivated in this country can be ranked on a par with the larch. Substitutes for the larch as a valuable timber-producing tree have frequently been recommended, but in the true sense of the word none can be termed substitutes except, indeed, in the narrowest sense, although doubtless some of those whose claims have been set forth might reflect one or more of its valuable qualities, but this is the widest limit of comparison.

Some recommendations in favour of the larch for afforesting purposes are:

1. The timber of no other conifer grown in this country is so valuable in a young state, as from an early age the thinnings can be profitably utilised for stakes, temporary fencing, and rustic work, which will not equally apply to any other of the family.

2. The larch in point of hardihood can favourably compare with any other, quite equalling the Scotch and Austrian pines when planted at high, exposed altitudes, even up to 1,100 feet.

3. The larch produces a comparatively large quantity of timber to the acre, and timber that is straight, clean, and easily manipulated, for above all conifers the larch is least inclined to throw its vigour into the formation of many and heavy branches. Then the durability of the wood of the larch is generally admitted, it being almost twice as lasting as that of the Scotch or Corsican pines. For mining and railway purposes the durability and lightness of the timber makes it much sought after, and at a higher price than that of any other coniferous tree grown in this country.

The timber is of a yellowish-white colour, tough, clean-grained, strong, and readily worked, and, above all, possessed of exceptional lasting properties. Though the larch is peculiarly suited for planting as a pure crop, yet the premature death-rate of the tree, owing to a cankerous disease, precludes such a course of cultivation, and mixing with hardwooded species is to be recommended.

Taking into account the hardihood of the

larch, rapidity of growth, and value of timber produced, the tree should be largely employed in every scheme of afforestation.

The Scotch pine, from a purely commercial point of view, is a valuable tree, and should be extensively planted, especially in light soils and at high altitudes. It will thrive in the poorest of soils, and in its requirements in the way of moisture it is one of the least exacting. Than that of the Scotch pine the timber of no other coniferous tree has been so extensively used during the last four years. Though the tree will grow up to an altitude of nearly 2,000 feet in this country, yet the perfect development takes place at a lower level—say between 600 and 800 feet. As to the soil in which this tree does best and produces the most valuable timber, that of a light gravelly or sandy loam, or granite-formation, and with a northern aspect, is preferred. The uses to which the timber is applied are many and varied, including pit-props, palings, builder's laths, stores and fencing. When planked out of large, old trees the timber is largely in use

for house joinery, boarding under slates, railway sleepers, temporary buildings, headings for barrels, boxes and packing-cases. For war purposes Scotch pine timber has been greatly in request by the Government, with the result that the price has advanced considerably. The Scotch pine is readily raised from seed, transplants freely, grows rapidly, is little subject to disease, and may well be placed next to the larch for extensive afforesting purposes. To sum up, there are few more accommodating trees than the Scotch pine, and, taking its economic importance into account, it is beyond doubt one of the most valuable trees for extensive planting.

The Corsican pine is peculiarly suited for all large planting operations, as it succeeds well in poor soils at high elevations. For general planting it is to be recommended, and Sir Andrew N. Agnew, Bart., says: "There is no tree that has come into general use during the last half a century which has proved so serviceable as the Corsican pine. At least, that has been the experience on the

Loughnow Estate, where it has been planted regularly for forty years." Similar experiences could be related from other estates, as at Penrhyn Castle, in Wales, where it is towering 20 feet above the other trees with which it was planted along the base of the Snowdon range of hills. For replanting ground where other species have died out the Corsican has been found invaluable. The timber is of fair quality, but has been tried to no great extent in this country; rather over-resinous, but strong, tough, and elastic.

To sum up, three very pronounced features of the Corsican pine for afforesting waste lands are:

1. The upright, towering habit.
2. The well-rounded and gradually tapering trunk.
3. The narrow outline and absence of heavy branches.

The Weymouth pine has thriven well in several parts of the country, but is somewhat fastidious about soil. In some parts of Surrey the Weymouth has done remarkably

well, a plantation of seventy years' growth having yielded a clear profit of over £69 per acre. At Cooper's Hill Park a small plantation of the tree turned out quite a success, the trees being tall, straight, and the wood of excellent quality. There are fine trees at Gwydyr Castle, in Wales, five of which contain fully 1,200 feet of timber. At Coworth Park, near Sunningdale, many of the Weymouths are over 100 feet high, and with ponderous trunks that carry their thickness so well that the stem diameter at 30 feet in height is little less than at ground level. They are growing in company with the beech, a guide to planters. In the woods at Woburn Abbey and elsewhere the Weymouth pine has reproduced its kind from self-sown seedlings, which augurs well.

Home-grown timber is of excellent quality, being light, clean, and easily worked, and under the name of white pine is largely imported to this country. I consider the Weymouth a valuable tree for afforesting purposes where soil conditions are favourable, and for the production of straight, clean timber it has

no rival amongst home-grown species. Unfortunately, the Weymouth suffers from insect attacks in most parts of the country.

The common and Sitka spruce are valuable trees for general planting, the timber of the former having been used in large quantities during the war. For planting in the northern half of Britain it is to be recommended. The timber, though of only second-rate quality, is of value for temporary work of all kinds, and, being light for its bulk and readily worked, has found favour wherever wide boards are required, such as for packing-cases, ladder-making, and shed-covering. Regarding the timber of the Sitka spruce, it is highly valued in connection with the making of aeroplanes, and, as the tree thrives well in this country, is to be recommended for planting wherever soil conditions are favourable. It has thriven well in many situations, and is being planted in large numbers on at least four of our best-wooded estates. In Wales it does particularly well, but has also attained to goodly proportions both in England and Scotland.

The Douglas fir is in certain restricted situations a valuable tree, but to grow it to perfection good soil and sheltered valleys are necessities. It is of very rapid growth, having been known to produce 240 cubic feet of timber in forty years. For general planting it is not to be recommended, but in afforesting large areas of ground suitable sheltered dips may be found in which it will succeed and produce a good volume of timber.

The silver fir grows to an immense size everywhere over the country, but the timber is comparatively rough and the lasting properties hardly second rate.

The above are the trees that will enter most prominently into extensive afforesting schemes, all being well-tried subjects and of economic value.

Of course, others may be tried, but for planting high-lying, exposed grounds well-tried subjects such as the larch, spruce, Scotch, Corsican, and white or Weymouth pines, will find a predominant place.

CHAPTER VII

FINANCIAL RETURNS FROM TREE-PLANTING

THOUGH the profit and loss account connected with timber culture is rarely entered into, yet on not a few estates, such as Woburn, Knowsley, Welbeck, and the Dukeries in England, and on the Seafield and other large estates in Scotland, accurate returns are available of the cost of forming plantations and the returns therefrom.

The financial returns cannot, however, in the majority of cases, be accepted as strictly correct; they are generally too low, owing to the woods being treated for other than commercial purposes; yet in several instances, where neither game-rearing nor ornamental effect have to be considered, the yield of timber and gross returns are quite reliable.

Of course, where game covert and underwood, or where the perfect development of

trees, as in ornamental plantations, are matters of first importance, and require that the individual specimens be grown thinly on the ground, the greatest yield of the best quality of timber cannot be expected; but where, as on various Scottish and a few English estates, the trees are grown thickly together and solely for their economic value, the case is quite different, and the returns of such will now be recorded.

One hundred acres of common land were planted from 1852 to 1862. Larch was the principal crop, with a few beech, Scotch pine, spruce, and silver fir. The plantation was thinned at intervals from 1871 to 1884, the thinnings being sold for close on £500, but many trees were used for fencing and estate purposes generally. The whole plantation was felled in 1907, and realised fully £4,500, or at the rate of £45 per acre. The larch on the lower portion averaged 23¼ feet per tree, but on the exposed ground they were only about one-third of that dimension. This plantation has a northern aspect, and is situated at from 800 feet to 1,300 feet above

sea-level. After allowing for the cost of planting and interest on money expended, the annual return per acre comes to about 20s. The adjoining heath-covered land lets for about 2s. 6d. per acre. Again, on the Countess of Seafield's estates, Scotland, on grazing land which formerly brought in 8d. per acre, Mr. Thomson, the wood manager, tells me that, at forty-seven years old, Scotch fir realised £40 per acre, while in another wood the individual trees brought 24s. 6d. each.

A larch plantation of 208 acres, on a steep hill-side, was felled at the age of fifty years. The actual returns during that period were —From thinnings, £4,500; from final felling, £14,500; or fully £90 per acre. The original cost of planting was under £5 per acre, and the value of the land at thirty years' purchase £7 10s. per acre, thus leaving a balance of fully £78 per acre at the age of fifty years.

Quite recently on the Earl of Moray's estate at Darnaway, Forres, a section of spruce timber that had been planted thirty-eight years ago was sold at £112 per acre. On the Penrhyn

Castle Estate, in North Wales, the actual profits on a larch plantation that was formed on hill-side ground, previously rented at 2s. 6d. per acre, was 11s. 3d. per acre for forty-two years; and on the Gwydyr property, near Llanrwst, the agent showed me the returns that had been got from a larch wood near Trefriw, which were rather above these figures.

The extensive hill-side plantations formed by the late Lord Powerscourt in Ireland, those at Glendalough in the same country; by the Duke of Athol between Dunkeld and Blair Atholl; at Glengoy, in Aberdeenshire; at Strathkyle, in Ross-shire; at Gwydyr and Penrhyn Castle in the Principality of Wales —all of which were formed over forty-five years ago, and the cost of formation and management strictly kept—are surely sufficient evidence not only of the profitable returns from woodlands, but of the feasibility of afforesting mountain lands, and the vast benefits that have been secured in the way of shelter to the dreary, treeless, and bleak,

exposed uplands where the planting has been carried out. As far as actual profits are concerned, it will be prudent to assume that for the first twenty years no return whatever will be derived from hill-side plantations, the thinnings up to that time doing little more than covering the expense of cutting and interest on first cost. From twenty-five to forty years an annual return of fully 12s. per acre has in many instances been forthcoming, while the value of the standing crop at the latter age has been found to vary from £50 to £70 per acre. I do not think that these figures would be, generally speaking, too high, as at Balfour, in Scotland, the larch at forty-three years' growth on a hill-side were valued at 20s. each, while a valuation of 21s. per tree was made on larch on the slopes of the Snowdon range of hills, in Wales, at the age of forty years. But many similar instances could be recorded, and are constantly coming before those who have to do with the valuing and felling of timber.

Mr. Lewis Miller, who has probably had a

larger experience of home woods than any other person, has given me some valuable and interesting information regarding what he has paid per acre for larch in various parts of Scotland. In twenty years, between 1870 and 1890, Mr. Miller has cut down growing timber to the value of over £250,000. A great many of the plantations were fifty years old, and yielded over £50 per acre when finally cut down, apart from the value of the thinnings taken out of them previous to the time they were cut down. To one proprietor in Aberdeenshire he paid £80,000 for plantations about fifty years of age, and the price worked out on an average at fully £50 per acre. One particular plantation of larch in Aberdeenshire, about seventy years old, yielded £150 per acre; another plantation, all larch, about forty-four years of age, gave over £100 per acre; and these plantations were for the most part growing on what was formerly pasture or waste land, and which cost for planting and fencing from £2 to £2 10s. per acre. It will be needless to multiply cases in which poor

lands worth only from 1s. 3d. per acre have been made to realise by judicious tree-planting as much as 20s. per acre for fifty or sixty years, with a final crop worth from £50 to £75 per acre.

Two other examples, given by Sir William Schlich at the Afforestation Conference in 1907, will further substantiate what we have said as to returns from British woodlands. The first is from Mr. W. B. Havelock, regarding a wood 18 acres in extent actually cut down. Mr. Havelock estimates the value of the land at £7 10s. an acre, because as soon as the wood was cut gorse and other shrubs made their appearance. Then he says the cost of planting that wood, including fencing, etc., came to £8 an acre. The value of thinnings is not known, but the old woodman asserts that several hundred pounds' worth have been taken out for sale and estate purposes. The value of the shooting is not given; I put it equal to the cost of looking after the wood. The age of that wood when cut was between seventy-five and eighty years, and it

gave the following results. There were:—1,328 larch-trees, 262 Scotch pine, 74 oaks, 116 beech, 35 birch, 12 spruce, and 120 ash.

So you will see it was somewhat of the nature of a mixed wood. The net receipts, after deducting all expenses of harvesting, selling, etc., were £2,835 3s. 10d., which is equal to £157 10s. per acre. Taking the mean between seventy-five and eighty years as the age of the wood, and allowing compound interest, I find that this wood has yielded to the proprietor 3·56 per cent.—that is to say, just a little over 3½ per cent. If the value of the thinnings were known and had been included, the rate of interest would certainly have been not less than 4 per cent.

The next example is a wood belonging to Sir Herbert Lewis. It is a larch wood of 208 acres, and was cut down some years ago. The locality is a very steep hill-side; the soil light sandy loam, but not deep. The rental value of the locality was originally given me at 5s. an acre per annum. Taking thirty years' purchase, the value of the soil comes to

£7 10s. per acre. The actual returns were as follows: From thinnings, £4,500; from final fellings at the age of fifty years, £14,500.

As the time when the thinnings were made is not given, I have thrown them together with the final yield, thereby making the calculation less favourable than it otherwise would be, so that the total receipts were £19,000, or £91 per acre, at the age of fifty years. I ought to mention there is some uncertainty about the cost of planting. I had been told that the total cost of planting and looking after the wood was £2,000, but Sir Herbert Lewis has made a further communication that the cost was not nearly so much. Under these circumstances I put down the cost of planting at £5 per acre, which, according to Sir Herbert, is more than it did cost. Now, the result of this is that the capital invested in this plantation has given all-round compound interest at $5\frac{1}{2}$ per cent.

All the plantations above referred to are excellent object-lessons of the possibilities of the British Isles for the production of high-

class timber, and of what British woods can yield if properly planted and managed.

Admit we must that some plantations have given poor or even no returns, but generally good reasons for the failure to do so are not far to seek. That well-managed plantations show a profitable return the above general examples, however, amply confirm.

CHAPTER VIII

ADVANTAGES OF AFFORESTATION

AFFORESTATION is essentially a national question, and as to profits, whether these are derived directly from timber sales or indirectly in the matter of hygiene, shelter, or improving the agricultural value of the adjoining lands, it will be recognised by all that to make trees grow where heath and gorse now thrive is deserving of equal credit with the "making of two blades of grass grow where one grew before."

No doubt, and rightly so, the planting of extensive woodlands will, irrespective of every other consideration, be carried out in such a way as to produce the best financial results. But not only from a strictly economic standpoint, as pointed out in the chapter on financial returns from tree-planting, but in an hygienic sense, as affording shelter for farm

stock, especially on exposed ground, improving the agricultural value of the surrounding lands, and clothing and ornamenting our barren commons and hill-sides, plantations will be found of the utmost importance; indeed, their value in such ways can hardly be over-estimated. Cases are numerous in which grazing land in the vicinity of recently formed plantations has increased in value from 2s. 6d. to 10s. per acre, and in one instance that has been brought to our notice exposed land that previous to the formation of plantations in its vicinity was rented at less than a shilling per acre now gives a return of twelve times that amount. On the Seafield Estate, in Scotland, the pastures adjoining forest land now let at a much higher rental per acre than was got for the ground before it was planted, because these plantations give shelter to the sheep farms around, particularly in the winter weather.

Twenty years ago I formed a plantation on a spur of the Snowdon range of hills, in Wales, where the fierce, long-continued, and hard-

hitting blasts were of almost constant occurrence, and the amount of shelter and warmth it now affords to the farm stock and lower-lying lands would hardly be credited. Previous to forming this particular plantation, which was at altitudes varying up to 600 feet, the adjoining lands were quite incapable of cultivation, but now crops are gradually creeping up the hill-sides, while the farm stock find the much-needed shelter and warmth that they were formerly denied. So great has been the benefit of this wood both to man and beast that the farmer on whose land it was planted speaks of it as a godsend. Other similar cases in Wales might be mentioned, as on the Gwydyr and Penrhyn Estates, and near Abergele, where the judicious planting up of rocky, almost worthless land has converted dreary and inhospitable districts into the most fashionable and expensive residential property. But in many parts of Scotland, particularly Perth, Inverness, and Aberdeenshire, equally good results have been obtained by judicious tree-planting.

Then there is the equally important advantage of finding profitable work for the unemployed, but as a special chapter is devoted to that important subject, it need only be mentioned here. Winter work for farm-labourers and cottagers in connection with coppice wood and its various manufactures must also be considered.

Excellent results, too, have followed in the wake of planting bog-lands in Ireland, and in 1862 my father formed several plantations there, a full account of which will be found in the *Transactions of the Highland and Agricultural Society of Scotland* for 1873. I examined these woods in 1900, and was agreeably surprised at the height to which the trees had attained, the cubic contents of timber, and price realised. Incidentally, it might be noticed that the ground previous to planting was a dreary, heath-clad waste, and only of value for snipe-shooting and the production of turf for fuel. But many such cases of the numerous advantages of tree-planting could be cited.

But there are other advantages to be derived from a well-organised scheme of tree-planting, not the least important being the greater facilities that would be afforded for disposing of the timber. In many outlying districts all over the country that are far removed from road and rail it is difficult to dispose of the small amount of timber that is periodically cut down, but, were larger quantities and a continuity of supply forthcoming, I feel certain that timber merchants would be prompted to make special transit arrangements. More than once I have been asked by Irish landowners to recommend buyers of good larch and oak timber, but, after negotiating, I have invariably been told by the merchant that the quantity offered was far too small to allow of special facilities for delivery being entered into, the timber, too, being far removed from road and rail. They stated, however, that if a specified number of cubic feet of good timber could be guaranteed annually for a number of years, they were quite prepared to buy, especially oak and larch,

both of which had a good sale in England. The same has been the case with timber in Scotland and remote parts of Wales. These, then, are cases in which a continuity of supply, as would be quite possible if my scheme of afforesting was carried out, would ensure speedy sales at moderate prices in places where at present it is difficult, if not impossible, to dispose of small quantities of timber unless at ruinously low prices.

CHAPTER IX

AFFORESTATION AND SCHOOLS OF FORESTRY

With the felling of fully a million acres of our woods for war purposes and the pressing necessity for afforestation, the question of establishing schools of forestry naturally comes to the front. Regarding the necessity for such schools opinions are much divided, and amongst the practical members of the woodcraft there is a decided aversion to these being established on anything approaching the lines of such as at present exist.

Probably there is no trade in the Kingdom to which so little science has been introduced, and there is certainly none other in which science would be more useful. There are many important points to decide in connection with timber, especially with reference to lasting properties and suitability for special purposes, not to speak of the best methods of

seasoning, preserving, and turning to account the so-called waste products of our woodlands. The diseases of timber, especially with reference to such as is used for mining purposes, deserve serious attention.

But in connection with the actual formation of plantations and successful timber culture the practical woodman must be employed, for it will be admitted by everyone who is at all interested in our home supplies of timber that the largest areas of the finest coniferous woods in the Kingdom are in the North of Scotland, and from which vast quantities of railway sleepers, poles of every description, and boarding for trenches at the front, have been obtained. What the War Office would have done without the supplies is difficult to say. Now, these very woods were planted, not by a pupil from a school of forestry, but a practical woodman, who had spent his early life in the woodlands of one of the Scottish estates where tree-planting, felling, and converting the timber, were systematically carried out. The premier

forestry posts in this country are filled by such men, and we see no reason why a practical forester should not be appointed at the head of every afforesting scheme. At Welbeck and Woburn the extensive woodlands are managed in a most satisfactory way by foresters who had their training on estates north of the Tweed, and the same applies to many other English estates.

But, indeed, nine-tenths of the most extensive and well-managed plantations in this country are supervised by practical woodmen, and these are the men to whom credit is most due for meeting the wants of the Government in the matter of timber supplies. Take as examples the woods at Cawdor, Darnaway, Scone, Durris, and other Northern estates, and it will be found that the foresters in charge of such have not been trained at any of the so-called schools of forestry, but received their early education in woodcraft under one or other of the capable Scottish foresters, to whose foresight, in conjunction with the landowners, we owe the

existence of the extensive woods from which adequate supplies of timber for the front have been obtained. There is no education for the forester like practical work at planting, pruning, felling, and converting the woodland produce, the so-called scientific teaching in a schoolroom with an attached dozen acres of plantations for botanical purposes being ill-fitted to produce the class of men that are required to supervise the formation and after-management of plantations in this country. As stated above, we are by no means averse to scientific teaching, but let it be in conjunction with the practical, for past experience and the present condition of Scottish woodlands clearly point out that in order to produce the best class of foresters a thorough training on a well-timbered estate is absolutely necessary.

Now that the Government has practically decided that the foundation of a school or schools of forestry is necessary, the questions crop up, Where and how should such be established? No better position than in connection with the afforesting of waste lands

could be suggested, every facility for the education of foresters and woodmen being present. First, there would be clearing, draining, and fencing the land, tree pitting or notching and planting, after which tending the woods, thinning and disposing of the woodland produce, either in a converted or unconverted state, would give an insight into the cultivation of timber which could not so well be otherwise obtained. The greatest drawback in connection with existing forestry schools is the want of woodlands, the result being that theoretical teaching has given place—to a great extent, at least—to the practical work. The Forest of Dean School is, however, a late exception. More than once I have had pupils from schools of forestry come to me to ascertain the names and peculiarities of our native trees and timbers. In order to have first-class managers of our wooded estates, it is imperative that the whole curriculum in connection with forest management, from laying out the ground to disposing of the produce, be gone

through, and this will require five years, at least, to be spent in the woodlands. As suggested to the Board of Agriculture, four schools of forestry might be initiated in connection with the afforesting of waste lands—one in England, Scotland, Wales, and Ireland—each school to be under the charge of a smart, well-educated British forester, whose duty it would be to superintend generally the laying out, fencing, and planting of such grounds as the State had acquired for the purpose, as also, with the aid of an expert, to impart to the assistant-foresters at classes held in the evenings, or at other times, such knowledge regarding the various outdoor operations as could not well be taught in the open. Preparatory to entering the State forests each pupil should have served at least three years on an estate where the management of woodlands was carried out, it, of course, being assumed that he had received a fair education. These assistants would act as foremen, and see that all work sketched out by the head-forester was properly carried

out, and impart such advice as might be necessary in connection with the everyday duties of the assistants. About five students could be kept at each of the four schools in England, Scotland, Wales, and Ireland, and, as my initial proposal is to plant 1,000,000 acres, this would give 250,000 acres for each of the four countries, which, spread over a period of twenty-five years, works out at 10,000 acres to be dealt with annually at each of the stations. I have purposely spread the planting over a period of twenty-five years in order to reduce the annual expenditure, and so as to ensure that by the time the last portion was dealt with the first formed would be annually producing a fair and increasing quantity of timber. Other portions would be coming on gradually in rotation, so that by the end of the twenty-fifth year almost every phase in connection with the management of woodlands would be in hand. It will be necessary to erect a substantial building at each of the four stations for the accommodation of the head-forester, his staff of assistants, lecture-

rooms, and storage-places for tools and other commodities. The assistants should remain at the school of forestry for a period of not less than three years, after which they may be allowed to fill vacancies as head-foresters when such crop up. By this means not only will the assistants receive a good insight into forest work generally, at a fair remuneration, but the State would greatly benefit by the employing of such men in the laying out, planting, and management of the woodlands. During that period of the year when thinning cannot be engaged in there will be plenty of work in the way of fence repairs, drainage, removal of rough-growing grasses from newly planted sections, and other needful operations; while, when the conversion of the timber comes about, greatly increased facilities in the matter of sawmills and other buildings will be required, and work will be general the whole year through.

The practical part of the education might include draining, fencing, planting, pruning, thinning, timber conversion, seasoning, and

preserving, as well as measuring and valuing, levelling, surveying, road-making, and the formation and management of tree nurseries. The home classes would include entomology—as far, at least, as the life-history of insects injurious to trees is concerned—diseases of trees and timber, utilisation of forest by-products, bird and animal life, chemistry, geology, book-keeping, plan drawing, and forest botany. During their stay in the State woods each pupil should receive a weekly wage, with use of rooms and free attendance at evening and other classes. For purely technical purposes these woods will not have arrived at their greatest value till after, say, twenty years, but previous to that the pupils may receive benefit by an occasional visit to some of the old Crown or private woods, where the felling and converting of heavy timber is in operation. From twenty-five years onwards the Crown woods will afford every facility necessary for the education of the young student. By such a system of procedure our foresters will be enabled to gain a

thorough practical knowledge of woodland work generally at no appreciable cost, while the State will receive at the same time valuable aid from the students at a small outlay per annum.

Regarding the most desirable places to establish these schools of forestry and commence planting operations, I would suggest those counties where not only the greatest area of waste lands exist, but where other advantages are offered, especially in the matter of cheap land purchase and easy removal of the produce.

CHAPTER X

AFFORESTING AND THE UNEMPLOYED

THE Prime Minister in one of his electioneering speeches said: "You also have forest lands which are unsuitable for higher cultivation. You have no idea how we were handicapped because we had to bring timber from Norway and Sweden and Canada, when you have plenty of land in this country that in the old days used to grow fine timber. There is no healthier occupation for the people than the planting, looking after, and cutting down of trees.

"Those of you who have lived amongst trees know that you get to love them. Get as many people as you can to live amongst trees, especially if you can plant them on hills.

"But I am told that a good many of those who have been living an open-air life do not want to return to the closer atmosphere of the workshop and factory."

There is no doubt that after the war a large

number of soldiers and sailors will not be able to resume their former occupations, and will, so to speak, be thrown on the hands of the Government, who will be expected, as far as possible, to assist in providing them with suitable employment. Various schemes will no doubt be formulated for so doing, but in the opinion of many one of the most pressing and important is the planting up of some of the waste lands of our country in order to provide timber for the future.

For many years there is bound to be a dearth of timber, and the all-round shortage of foreign supplies will cause a constant drain on our now very limited home productions. There are other reasons as well as those mentioned why tree-planting on an extensive scale should be put in hand at once, some of which are that, owing to the interruption of supplies from abroad and the heavy inroads that have been made on our home supplies during the past four years, a shortage of the necessary requirements will quickly come about. In addition, Russia will not be in a position for a long period to organise labour so that the

pre-war amounts can be sent to this country; while French forests have been severely depleted for war purposes, as also whole forests rendered useless by shell fire.

Under the circumstance and confronted as we must shortly be with the serious question of unemployment, a practical solution of the labour problem—in part, at least—will be found in the planting up of some of the vast tracts of waste lands that are to be found in many districts of the country. The question of utilising unemployed labour in the planting up of some of the waste lands of our country is not one of recent birth, as may be seen from early editions of my "Forester's Diary" and "Practical Forestry," and from special articles which have appeared in the *Timber Trades Journal* and other papers.

In order to carry out my proposed scheme of planting a million acres during the next twenty-five years, or at the rate of 40,000 acres annually, profitable and healthy employment would at once be found for several thousand workmen. The question of transporting, housing, and otherwise dealing with these

workmen has been brought forward as the most serious drawback to the scheme, but personally, having had to deal with such cases, I can see no insuperable difficulty; and surely, if our railway and water companies, as also private landowners, can deal with hundreds of men in remote mountain districts that are far removed from road and rail, the Government could arrange the necessary for the various bodies of workmen that would be employed in afforesting purposes. Nor must tree-planting be considered as a new departure of unemployed labour, as in the formation of a large plantation on a dreary, exposed hillside in Wales the whole of the work, including clearing the ground of rough surface growth, draining, pitting and planting, was most successfully carried out by detachments of the unemployed under my personal supervision.

The general physique of Army and Navy men, and the discipline and hard work to which they have been subjected during the war, render them peculiarly suitable for carrying out the various operations connected with the formation of plantations. Convalescent soldiers

and sailors could also find healthy employment at the various lighter works which go hand-in-hand with afforestation, such as clearing the ground of rough-growing vegetation and lifting and distributing the young trees.

Several suggestions have been made for providing employment for our returned soldiers and sailors, but much of this proposed work is, so to speak, created, and would probably never be entered into but for the exigencies of the case. Now, I am quite of opinion that afforesting waste lands offers a sensible system of employment, for it is now generally admitted that a greatly increased area of our woodlands is imperative and a pressing necessity, and, what is of equal importance, the undertaking, if wisely entered into, would not only increase the value of such lands fourfold, but form the nucleus of an ever-increasing revenue of the State.

The war has brought home to us in no unmistakable way the requirements of a nation in order to carry on hostilities, and should act as a timely warning to we islanders regarding future home supplies of timber.

But this is not all, for apart altogether from the question of immediate labour, what an industry would be opened up in years to come by the planting of waste grounds. At present there would be the clearing, fencing, draining, and planting the ground; then tending in various ways would give employment. Thinning would commence about the tenth year, and after about twenty-five years the erection of sawmills and converting the timber would open a vast and ever-increasing industry, as well as provide highly remunerative work to thousands of the unemployed.

There are other ways in connection with forestry in which the unemployed could be usefully and profitably set to work, such as in preparing osier-beds, planting dogwood for gunpowder charcoal, and in the formation and stocking of tree nurseries, the produce of which could with advantage be used in the formation of plantations. The latter would give light employment to several hundred men during the whole of the year. Osiers for basket-making, charcoal for gunpowder and heating purposes, and seedling plants for

afforestation, will all be greatly in demand after the war, when foreign supplies will not be forthcoming.

Regarding the most desirable centres to commence planting operations, I would suggest those counties where not only the greatest areas of waste lands exist, but where advantages are offered, especially in the matter of cheap land and demand for and easy removal of the produce. Thus we have:

England: Yorkshire and Northumberland, with 1,010,924 acres.
Scotland: Inverness and Argyleshire, with 3,087,312 acres.
Wales: Breconshire and Merionethshire, with 416,320 acres.
Ireland: Donegal and Kerry, with 657,337 acres.

(Exclusive of 172,436 acres of bog-land.)

From these figures it will be seen that were such necessary we could get all the ground required for this afforesting scheme in one county of England and Scotland and three of Wales and Ireland.

The cost of procuring suitable land for afforesting purposes need be no drawback to the scheme, and from extensive enquiries

made the price on an average would, as before pointed out, not be greater than £2 per acre.

The cost of forming plantations has been very carefully considered, and for all practical purposes may be put down at £5 per acre, taking the British Isles as a whole.

Regarding financial returns from tree-planting, there is overwhelming proof that land worth only from 1s. to 3s. 6d. per acre has been made to realise as much as 20s. per acre for fifty to sixty years, with a final crop worth from £50 to £75 per acre.

Taking everything as above into consideration—price of land, cost of planting, and financial returns—it will well repay the State to plant up uncultivated and waste lands, work that there should be no loss of time in setting about if we are to provide suitable employment for our returned soldiers and sailors and avoid the threatened timber famine which the well-informed tell us is fast approaching.

Bearing on the question of providing work for a number of our demobilised soldiers and sailors, the following account of the afforesting of a considerable area of mountain land in

Carnarvonshire, North Wales, by unemployed labour may be valuable to others who have the arranging and carrying out of extensive schemes of tree-planting, as proposed by the State.

During the strike of workmen at the Penrhyn Slate Quarries the idea occurred to the late Lord Penrhyn to afford suitable employment to a number of the men by planting up a considerable area of ground on an exposed spur of the Snowdon range of hills. One wood in particular that was formed under the supervision of the writer by unemployed labour is now an object-lesson, not only in what can be done in the planting of comparatively waste mountain land, but also by uninitiated workmen when placed under proper supervision. The plantation referred to extended for a considerable distance along the hill-side, ranged in altitudes from 500 to upwards of 600 feet, and was fully exposed to the long and hard-hitting winds blowing in from the Irish Sea. Previous to planting, this ground, with hundreds of acres of the adjoining hill-sides, were rented by the ad-

joining farmers as sheep pastures at a few shillings per acre. Gorse, broom, heath, and the dwarf willow, constituted the shrubby vegetation, other plants including the parsley and hay-scented ferns in abundance; while the vaccinium, cotton-grass, sundew, and sphagnum, tenanted the damp ground. The higher side of the area planted was protected by a stone wall, the lower boundary being an iron and wire fence. The preliminary work consisted of clearing the ground of all rough-growing vegetation that might impede planting operations, drainage where necessary, and levelling over a few ditches and turf fences that had existed in years gone by. Everything being in readiness for straight-ahead work, about a hundred quarrymen were engaged as a start, few of whom lived nearer than two miles from where the plantation was being formed. They brought their food with them, which was heated on the ground in a rough temporary shelter, which also served for rest and recreation. Pay was at a similar rate to that on the estate, and each man was provided with the necessary tools for pitting and planting.

In charge of the squad were a general foreman and several gangers, whose duty it was to mark off where the holes were to be dug out, and generally supervise operations. The men worked in line and in batches of twenty, digging the pits to the stipulated size of 15 inches square and 12 inches deep, the bottom and side of each pit being loosened up by means of a fork or pick where the soil was not considered sufficiently friable for the reception of the young trees. The top turf was removed in two halves, about 2 inches thick, and after being thoroughly chopped up by the spade was placed in the bottom of the pit and covered with a small quantity of soil. By so doing the pits were left ready for the reception of the young trees, and by the time that the whole of the ground was so treated the first-opened holes and soil had received the benefit of their exposure to the weather. Tree-planting was carried out by the same staff of workmen, with the aid of boys for holding the plants and keeping them in an upright position whilst the roots were being covered with soil. Here a good deal of

supervision was necessary, not only to ensure that the plants were well headed to the prevailing wind, but that the strongest roots were spread out in the same direction, and covered to a proper depth with firmly tramped soil. No fault, however, could be found with the general style of workmanship, and though most of the men were uninitiated in tree-planting, and had to walk a distance of two miles before commencing and another two after finishing their work, yet their attention to hours and general discipline was everything that could be desired. The men were paid on the ground.

It has been argued that, as tree-planting is skilled or specialised work, the general class of unemployed are unsuited for it, but such is by no means the case, as the above and other instances which could be pointed out illustrate.

When willing and placed under proper supervision, man is very adaptable, as was found when several hundred of the real unemployed were found work, some of which was of a rather intricate kind, in the London parks a few years ago.

CHAPTER XI

COMPARATIVE VALUE OF BRITISH AND FOREIGN TIMBER

Previous to the war, wood merchants generally, but particularly dealers in foreign wood, had a poor idea of home-grown timbers when compared with those sent from abroad. But times have changed, and with the compulsory use of that of home growth, to the almost total exclusion of the foreign article during the past four years, the quality and uses to which it can be applied have undergone a thorough test, with the result that British-grown timber is now widely appreciated and can well hold its own with most of that sent from abroad.

No oak, even the much-vaunted Bavarian, can compare with that of British growth, and the same may be said of ash, beech, and sycamore, all of which can hold their own with the very best of that sent in from

foreign countries. That much foreign oak is vastly inferior to our own has long been recognised, and the fact is borne out, not only by everyday experience, but by modern and ancient examples in our buildings, which date from the tenth century down to the present day. Then, as to brown oak no comparison need be attempted, as such is peculiar to Britain, and incidentally it may be stated that the magnificent dining-room in the White House at Washington is entirely panelled with English brown oak. The timber is of beautiful grain and colour and of considerable value, ranging in price up to 10s. 6d. per cubic foot, and fully £100 has been paid for average-sized trees of the brown oak.

Neither in price nor quality can any foreign-grown ash timber compete with that produced in this country, and for the important uses in aeroplane construction it has no equal.

Some years ago German clog-soles held the sway in this country, but after a fair trial of our home-grown alder the foreign product

was well-nigh ousted from the market. Take beech timber, and it has been proved over and over again that that of home growth, which is hard and firm, especially when produced on chalky formations like the Chiltern Hills, is in every way preferable to the softer-grown Continental wood. The war has brought home to us how useful beech timber is and for what a large and varied number of uses the best class is suited. Repeated trials with foreign beech timber have quite convinced the trade that it cannot compete with the best of home growth.

Cricket-bats made from English-grown willow have no equals, and are sent from this country to every part of the world. Chestnut timber is well known for its lasting properties, and in many of our old buildings has been in position for centuries and is yet perfectly sound. Users of walunt for specially important purposes tell me that the best-grown home wood can rival any sent from the Continent, and has recently been used in preference, and advertisements in our timber trade

journals often specify that of British growth in asking for quotations.

Regarding coniferous woods, home-grown larch, when free from disease, is quite on a par with any that is grown in its native country. Then, Scotch fir timber has been proved on many occasions lately to quite equal the same kind when sent from the Baltic and other parts, and for constructional work has in certain cases been preferred.

For the less important and temporary works, Scotch pine timber, owing to being obtainable in straight, clean, and large boles, is much sought after for boxes and packing-cases, temporary fencing, and, when old and resin-stained, it has been successfully employed both in house and boat building. For some unaccountable reason, the timber grown on the granite and gravelly soils of Northern Scotland is far superior to that produced in other parts of the country, where certainly the tree thrives best and contains the largest quantity of the most valuable wood. So lasting is the timber of Scotch growth that

planks cut from trees that were used for boat-building fully two centuries ago are yet perfectly sound, as might have been seen when these were exhibited in London at some of the collections of wood of late years. The Scottish woods and plantations have, however, got a clearing out during the past four years, and lucky it was that the forethought and perseverance of the Northern lairds caused this useful tree to be planted in such quantities on their estates. The famous Ballochbuie Forest, owned by the King, and others in Aberdeenshire, produce the highest class of Scotch fir timber, many of the trees in these woods containing over 150 feet of timber—clean, long, and of excellent quality. Some of the timber used in making Balmoral Castle was Scotch pine grown on the Royal estate.

To anyone who is interested in the question of the lasting properties of our native woods we would advise them to examine some of the buildings that were erected over seventy years ago, both in Wales and Scotland, or, nearer still to the metropolis, at Chesham, where

several houses built nearly half a century ago of home-grown timbers are as sound to-day as when they were erected. Not long ago we had the opportunity of examining a cottage the timber of which was used experimentally by the proprietor, who had a more than passing interest in the value of home-grown woods for building purposes. The timber used in this particular instance was that of the common spruce from old trees grown on the estate and seasoned and converted on the spot. It is really marvellous to see how the beams and purlins have stood the test of time, though one important fact should be stated—that the timber during the seventy years was not subjected to atmospheric changes, the building being perfectly dry. A well-known house in Aberdeenshire was built in 1593, which date it bears, and the lintels of the windows and other parts are of home-grown spruce, and were found in good condition when recently removed. Well-seasoned spruce timber, say of from seventy to one hundred years' growth, is most

valuable for constructive purposes when it is not subjected to wet and dry alternately.

But even in this case we, some time back, were asked to look at a ladder that for thirty-seven years had been in use for thatching the corn-stacks on a large farm. This, too, was made of spruce, for which, owing to its lightness, the timber is peculiarly suitable.

The main reason why home-grown timber has not been more frequently in use amongst architects and builders is because it can rarely be got in a dry and seasoned condition and fit for immediate use, nor in the sizes, quantity and quality, and at the time required. On the other hand, foreign wood has been sent to this country in a matured and thoroughly seasoned state, and can, on the shortest notice, be procured in the different sizes and scantlings required for any and every class of constructive work, while it is clean to handle and moderately cheap. Now, however, that unprecedented quantities of our native woods have been used for the most important purposes in connection with the war, their par-

ticular qualities have been amply demonstrated, and have proved to the sceptical that timber of home growth, in several cases at least, can well hold its own with any that is sent from abroad.

In the matter of timber utilisation we are, as a nation, extremely wasteful, and all the more so when the small area of our woodlands is taken into account; for it has been carefully computed that, comparatively speaking, about one-fourth of every tree felled goes to waste. We have first to consider the thousands of tons of lop and top that are left to rot in many woodlands; and even at the present time and in face of a dearth of fuel many plantations in the Home Counties, where extensive fellings have of late taken place, have simply been scoured for the best timber, the valuable tops, vast quantities of excellent firewood, and mountains of branches, being left untouched. From an economic point of view this is a terribly wasteful policy, and requires stern measures to turn such wood to some profitable

account. Twenty years after the famous Tay Bridge gale, when so much timber was uprooted all over the northern half of the country in particular, the writer saw half-rotting spruce and other trees in many of the Scottish woodlands. Then, as well, many by-products of our woods and plantations are lost and chemical wealth wasted, instead of being turned to some profitable commercial use, as is done in most of the Continental forests. We are sadly out of date in the matter of utilising wood waste generally, a fact that is clearly brought home to anyone who wishes to pay a visit to the French seaside plantations, where the comparatively useless timber-producing Pinaster or Cluster pine is utilised to the fullest extent in the production of chemical by-products. What a wealth of sawdust is lost owing to our non-adoption of Continental practices in turning such to many useful purposes for which it is so well adapted.

CHAPTER XII

TIMBER TRANSPORT

The Prime Minister in one of his recent speeches referred to the excessive cost of transporting timber, and suggested that the utilisation of canals and other waterways should receive attention. Railway rates are ruinously high, the cost of delivering timber and pitwood from the woodlands to the consumer being so excessive that little or no profit is left to the owner.

Many cases could be pointed out in which, in recent years, the actual cost of haulage to the railway siding and cost of carriage to the destination have exceeded the original price that was received for the timber.

The cost of both haulage and railway transport of round home-grown timber is excessively high. It is only possible, how-

ever, to give an approximate price for either, so much in the haulage line at least, depending on situation of the woodlands, accessibility, condition of roads, and rate of wages ruling in the particular district from which timber is being conveyed. A few examples of the actual prices that have been paid during the past three months may be interesting. Three miles from a railway station, with a soft approach to a rocky plantation, the price paid was 8d. per cubic foot; another haul seven miles distant from rail was also 8d. per foot. Delivering mixed wood three miles to Bromley Station, in Kent, cost 3½d. per foot. Putting the various prices together, we came to the conclusion that during the whole of the past year the cost was a fraction over 2d. per foot per mile for timber, and pitwood 3s. 10d. per ton per mile. Railway rates from Bagshot to South Wales were 15s. per ton, and in Scotland birch timber for 160 miles cost for carriage 19s. per ton. The cost of carriage of beech-trees from Sussex to the Chiltern Hills was more than the owner of those trees had

obtained for 150 years, as reported to the Conference on Afforestation in 1907. But many similar cases of excessive haulage and railway rates could be given, and it will thus be seen that the question of cost of transport is a vital figure in the financial success of timber culture. The use of our canals and other waterways, as pointed out by the Prime Minister, will go far in lessening the cost of timber transport, and should be enquired into.

In the second Report, published a few days ago, of the Select Committee on Transport it is stated that, in comparison with the railway system of the United Kingdom, its waterways are at present relatively unimportant. Excluding open rivers, "waterways" are canals and canalised rivers or "navigations." The total mileage of canals and navigations is about 4,670 miles, of which 3,639 miles are in England and Wales, 183 miles are in Scotland, and 848 miles are in Ireland. Of the total mileage, 3,310 miles are independently owned or controlled by public bodies or companies,

and 1,360 miles are owned or controlled by railway companies.

During the war the Government has controlled practically the whole of the main waterways of the United Kingdom, either through the Railway Executive Committee, which controls the railway-owned canals, or through the establishment of the Canal Control Committee, which controls 1,226 miles of independent waterways in England and Wales and 304 miles in Ireland. In England and Wales 2,251 miles out of about 2,500 miles of the most important waterways are under Government control.

The railway-owned canals have been managed by the Railway Executive Committee, which has been represented on the Canal Control Committee by the acting manager of the London and North-Western Railway Company. There can be no question that the arrangements which have been made for the working of the canals during the war have been of great public value, and have relieved the railways of a considerable volume of heavy

traffic with which they found it difficult to cope. The Committee, in the absence of further evidence which it desired to take, has not been able to come to any conclusion in regard to the most advantageous organisation for dealing with the canals, except that further amalgamation would be advantageous.

The question of cheaper transport facilities for timber is one of vital importance in connection with afforestation and the delivery of every kind of woodland products, and it is to be hoped that means will be provided whereby the waterways of our country can be fully utilised in the transport of such.

Converting the trees into boarding by sawing in the woodlands is another way of greatly lessening the expense of carriage, and in several instances that could be brought forward the travelling sawmill has done useful work in reducing the cost of transport. Instead of sending the trees away in bulk, conversion by sawing is strongly recommended as a saving to carriage, as heretofore a great proportion of the value of the timber is lost in getting it

into a suitable market. With the utilisation of our canals and other waterways and conversion of the trees by sawing in the woodlands, a great saving in the cost of carriage will be brought about.

CHAPTER XIII

FORESTRY SUBCOMMITTEE OF THE RECONSTRUCTION COMMITTEE

It is very desirable in connection with afforestation that the findings and recommendations of the above Committee, recently published, should be given the widest circulation and most favourable consideration. The Subcommittee found that 2 million additional acres in this country could be devoted to timber-production without decreasing the home production of meat by more than 0·7 per cent., and that if the land were so used the cultivation would ultimately afford employment for at least ten times the number of men now engaged on that area. In order to render the United Kingdom independent of the importation of timber for three years in any emergency, it is necessary, the Committee say, while making the fullest allowance for an extended

yield from existing woods, to afforest 1,770,000 acres in eighty years, 1,180,000 being planted during the next forty years as follows: 150,000 acres planted by the State; 50,000 acres of denuded areas to be restocked; 25,000 acres to be planted by private individuals and local authorities; 25,000 acres to be proceed shares; making a grand total of 250,000 acres.

The cost of this work is estimated at £3,425,000 for ten years, and during forty years it is approximated by the Committee that £15,000,000 may require to be invested in the undertaking. In view of the scarcity of timber in the United Kingdom since the war began, and the great difficulty experienced in obtaining the very large amount of pit-props wanted to allow coal-mining to be carried on as desired for the next ten years, the percentages of the total area under wood of different European countries, given by the Committee, are interesting, and fully confirm their findings and recommendations. The following percentages of total area under

wood are given: United Kingdom, 4·0; Sweden, 47·6; Russia in Europe, 37·0; German Empire, 25·9; Norway, 21·0; France, 18·2; Belgium, 17·7; Europe (1900), 31·0.

The percentage of woods belonging to the State in each country is given as: United Kingdom, 2·4; Sweden, 33·2; Russia in Europe, 66·4; German Empire, 33·7; Norway, 28·5; France, 12·0; Belgium, 4·8.

The conclusions arrived at by the Committee are certainly pregnant and to the point that "The whole sum involved is less than half the direct loss incurred during the years 1915 and 1916 through dependence on imported timber"; and, further, that at least 2,000,000 acres of land in the United Kingdom could be devoted to the cultivation of timber without real detriment to existing industries. The Committee also recommends, or rather estimates, that approximately 100,000 acres of hardwoods will require to be planted in order to render the Empire safe in future wars.

With these findings and suggestions of the Subcommittee no one will disagree, the only

regret being that almost similar propositions that have been made during past years were not carried out at the time. In the opinion of those who are well competent to judge, the area to be afforested is too small and the period over which the planting is extended too long to be of any practical value in the way of meeting our wants in the near future in the matter of timber supplies.

With reference to the length of rotation, it would probably have been more consistent with facts had sixty instead of seventy or eighty years been substituted. Most coniferous trees increase but little in bulk and are ripe for felling at sixty years—in fact, after that age spruce is on the decline for the most important uses to which it will be applied. Hardwoods, on the other hand, leaving aside those specially set apart for pit-props, require a long rotation, and for this very reason are most suitable for State planting, one hundred and fifty or two hundred years being nothing in the lifetime of an oak. Mining timber, however, will arrive at a suitable age for felling

in twenty-five to thirty years, and is therefore to be recommended for short rotation or where the planter wishes to receive proceeds of outlay during his own lifetime.

From a purely national point of view our future supplies of pit-wood will require serious attention when afforestation is taken in hand by the Government and private landowners. Experience has pointed out that all the pit-wood necessary for our own wants can be grown at home, and from a forestry point of view the cultivation of such will be attended with a considerable margin of profit; while it has this advantage over the growth of heavy timber, in that the planter will reap the rewards of his labour during his own lifetime —a serious drawback in the past to the formation of plantations the produce of which does not arrive at maturity for a century at least. With the average class of prop-wood from twenty to twenty-five years suffices to produce that of just the sizes required, so that the planter has every prospect of reaping the benefits from planting that he may engage in

in early life at least. There has in the past been a great waste in pit-wood, quantities that have been consigned to the charcoal-maker and for firewood purposes being eminently suitable for coal-mining work generally. In the past there has been so great a choice of pit-wood that buyers have been dissatisfied with any other than that of first quality, the second rate being, as a rule, discarded. We have often thought, when supplying excellent home-grown timber to our larger collieries as pit-chocks, that wood of first quality and sawn could well be replaced by that of inferior growth and axe-squared in the woodlands before delivery. But scarcity will teach a lesson that it would have been impossible otherwise to instil into the minds of the average timber consumer. The coal-production of the United Kingdom is roughly 250,000,000 tons per annum, and as the use of 1 ton of timber is required for every 70 tons raised, it will be seen that about 3,500,000 tons of pit-wood is every year consumed in connection with the obtaining of our coal-

supply. In connection with the supply of pit-wood an important consideration is the almost entire dependence of one of our chief industries on the foreign market, for if the supply of pit-wood were by any means stopped, such as a European war or dislocation of rail or shipping, our coal-mines in a very brief period would require to seriously curtail work or shut down altogether. We have no supply of pit-wood to fall back on, or at least our supplies are very limited. The table showing the average annual amount of timber, both converted and unconverted, including pulp of wood, that could be grown in the United Kingdom is interesting reading, though it is open to doubt whether the amounts will ever be realised—coniferous in particular. Taking the acreage as 1,750,000 and the expenditure as £15,000,000, this works out at £8 16s. 5d. per acre, which is slightly in advance of the amount we have suggested for many years back, and no doubt brought about by the existing higher rates of wages and materials.

Private individuals and our forestry societies have long been labouring to get the authorities to realise the importance of the question of afforestation, but with very little success. The experiences of the war have, however, taught us a lesson and done what no amount of reasoning was able to accomplish, and the Government have at last begun to realise the necessity of providing an adequate amount of home-grown timber.

CHAPTER XIV

GENERAL CONCLUSIONS

THE policy advocated throughout these pages may be briefly summarised as follows:

The necessity for a greatly extended area of our woodlands is generally admitted. The area suggested for a start is 1,000,000 acres, to be planted over a period of twenty-five years, at the rate of 40,000 acres per annum.

State ownership of the woodlands is strongly recommended, the resources and continuity of a nation making it the best custodian of forest property; indeed, only the State can provide the necessary capital or acquire land on the most favourable terms and in sufficient quantity. Regularity of action and extensive wooded areas are first necessities to successful timber culture.

Private individuals and public bodies labour under many disadvantages in this respect,

not the least being the thirty or forty years required before the money expended on planting can be even partially repaid. Grants of money might, however, be made by the Government to estate owners and municipalities on some well-devised scheme in aid of afforestation.

Afforestation should be carried out on broad inclusive lines and in the interests of the nation as a whole, and in order to ensure uniform policy and administration the establishment of a Board of Forestry for the whole of the United Kingdom is strongly recommended.

Unfortunately for forestry, the President of the Board of Agriculture is changed with every change of Ministry, the policy thus being in the hands of the party in power, and therefore subject to complete alteration. Forestry should have nothing to do with politics, as once a policy like afforestation has been settled it should not be liable to change, and the officials connected with it should be permanent.

The planning and controlling of any forest scheme should be under the best expert authority. Voluntary replanting of denuded areas will never make up for the wholesale destruction of our woodlands during the past four years, which makes it imperative that compulsory powers be enforced and State aid invoked before tree-planting on an extensive scale to meet our wants is brought about.

The utilisation of canals and other waterways in the transport of timber is strongly recommended, one of the most serious drawbacks to the successful exploitation of home-grown timber being the excessive cost of carriage.

Railway rates are ruinously high even for short distances, and when to this is added the cost of haulage to the railway-station, little is left for the grower of the timber.

Converting the timber by sawing in the woodlands in order to reduce cost of carriage is also recommended. The travelling sawmill has done good work of late years.

Unskilled labour, such as clearing the ground, drainage, soil work, and pitting, may

all be engaged in by the uninitiated when placed under proper supervision.

In afforestation the best trees to plant are such as will produce the largest amount of the most valuable timber in the shortest space of time.

Schools of Forestry—one for England, Scotland, Wales, and Ireland—are recommended, the practical part of the education going hand-in-hand with afforestation.

Home-grown timbers, five at least, have been proved to equal, if not surpass, in quality any that has been sent from abroad.

The advantages of afforestation, apart altogether from the value of timber produced, in the matter of shelter to farm stock, improving the agricultural value of the lower-lying ground, and clothing our bare hill-sides with vegetation, can hardly be overrated.

To keep pace with war requirements fully one-third of our best timber has been sacrificed, and what remains is likely to be heavily drawn upon during the next few years. And, what is equally alarming, with the forests of

France and Belgium widely wrecked by shell fire, Russia in its present unsettled condition, and American supplies fast vanishing, we can no longer depend on the liberal supplies to which in pre-war days we were accustomed. Germany cannot help us, for in the year before the war the value of her own imports exceeded £14,000,000.

It may be said by some that the timber of our foreign possessions will partly fill up the gap, but such is by no means the case. Indian timber and that of the great African forests, though for special purposes and as ornamental woods they are invaluable, are hardwoods, and, as a rule, unsuited to our wants. The South American forests are on a par with those of India and Africa, while both China and Japan require more timber than they possess.

The war has taught us a lesson, and we must profit by the teaching; for never before has so much timber been used in trench warfare or as an adjunct to actual fighting. To this end the country was stripped from north to south of its best timber, and at the same

time it has very forcibly been brought home to us that our reserves were totally inadequate, and that for mining purposes, at least, large quantities had to be imported. The present war has also clearly demonstrated that we are, in the case of a European war, both too near the Continent and too far removed from our usual source of timber supplies.

There are one or two matters in connection with the formation of plantations that I must not omit to briefly mention, and on which the success of the undertaking wholly depends. These are:

1. Strict economy in the formation of the plantations.

2. Suiting trees and soil, and studying local demand and conditions.

3. Careful and timely thinning, bearing in mind that the timber is being cultivated wholly for its economic value.

4. A bold, well-planned, and continuous policy.

5. Efficient supervision.

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